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ISSUED QUARTERLY

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OF THE
New England Water Works Association
1955 - 1956

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THE Association was organized in Boston, Mass., on June 21, 1882, with the object of providing its members with means of social intercourse and for the exchange of knowledge pertaining to the construction and management of water works. From an original membership of only TWENTY-SEVEN, its growth has prospered until now it includes the names of over 900 men. Its membership is divided into six classes, viz.:

A Member shall be an officer or employee of a public or private water works, an engineer, chemist or other person qualified to aid or interested in the advancement of knowledge relative to water works.

An Honorary Member shall be a person of acknowledged eminence in some branch of water supply or of engineering.

A Junior shall be not less than eighteen years nor more than twenty-five years of age, a student or connected with water supply work.

An Associate shall be either a person, firm or corporation engaged in manufacturing or furnishing materials or supplies for the construction or maintenance of water works.

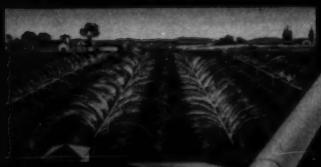
A Corporate Member shall be either a Water Board, Commission, Company or Municipal Corporation.

The initiation fees and annual dues are as follows:

	Initiation Fees		*Annual Dues*
Members	$ 2.00	Members	$ 4.00
Juniors	1.00	Juniors	2.00
Associates	10.00	Associates	20.00
Corporate Members	10.00	Corporate Members	10.00

This Association has at least eight regular meetings each year, of which five are held in Boston, one in northern New England, one in southern New England, and one, the annual convention, held in September or October on such date as the Executive Committee may designate.

WATER YOUR PLANTS AND WATCH THEM GROW!



Today, water is as basic to industrial development as it always has been to agriculture. Since thriving industry is essential to the growth and prosperity of the community, a water supply system capable of sustaining a high rate of industrial expansion is a prime concern of the community.

Such a system requires that the water supply and distribution pipelines be as efficient and indestructible as is economically possible. In pipelines 16 inches in diameter and larger, this can best be realized with LOCK JOINT CONCRETE PRESSURE PIPE.

This Lock Joint pipeline has high carrying capacity throughout its exceptionally long life. It will not rust or corrode, requires very little if any, maintenance and is guaranteed to be free of pitting, trouble free service is unexcelled.

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Sales Offices: Chicago, Ill. • Columbia, S. C. • Denver, Col. • Detroit, Mich. • Hartford, Conn. • Kansas City, Mo.

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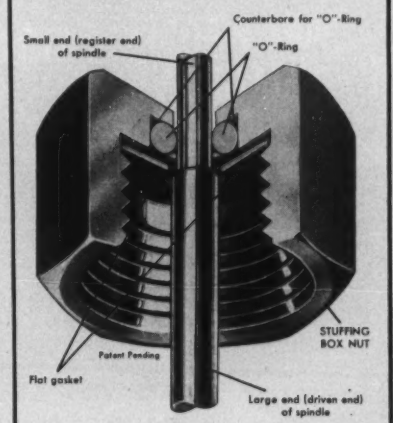
Eliminates Stuffing Box Leaks, Binds, Troubles, Expense...

Three Years of Proven Success In The Field

The Rockwell "O"-Ring Stuffing Box Nut Assembly was perfected over three years ago. After extensive laboratory and field tests and without any "fanfare" or publicity it has been used in Rockwell water meters built since that time. The superior performance of "O"-Ring construction is now a proven fact. It provides a permanent, leak tight seal at a very vulnerable point. And it actually improves meter performance by reducing friction at the stuffing box spindle. You get it only in Rockwell meters of all sizes and types. There's no extra cost, but a lot of extra value and satisfaction. Ask your Rockwell representative to demonstrate this great new advance in water meter construction.



Cutaway View in Enlarged Detail

HOW IT WORKS

This sectioned view shows how the "O"-Ring press-fits into a counterbore in the packing nut. The counterbore has a slightly smaller diameter than that of the "O"-Ring to hold the ring under compression. This slight compression alone seals the stuffing box spindle bottle-tight *without binding*. The nut can be force tightened with a wrench without applying any additional compression.

The Rockwell "O"-Ring assembly is also available as an economical replacement part. It is interchangeable with the stuffing box nuts on all earlier model Rockwell meters.

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Two Symbols of PERMANENCE *and* DEPENDABILITY

Having withstood centuries of exposure to wind and weather, the Pyramids of Egypt are symbolic of "Permanence".

Similarly, this pipe cast by Warren in 1862 is still in service and has proved its *permanence* and *dependability*.

Over $1,000,000 saved by reusing 93 year old Cast Iron water pipe

While this cast iron pipe was produced in our foundry nearly 100 years ago and serves to give added proof of the *durability* and *permanence* of cast iron pipe installations, this example is by no means either exceptional or even one of the oldest of recorded long-time service.

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This unique club whose membership is made up of those cities in the U. S. A. having cast iron pipe installations of 100 years of age or more, was established by the Cast Iron Pipe Research Association in 1947. Today's membership is 69 and is growing regularly.

BIG SAVINGS

In addition to the value of permanence and uninterrupted service, many cities and communities are realizing sizable dollar savings in instances where extensions or various changes in layouts need be made. With the pipe illustrated, Jersey City, New Jersey, was able to clean, relay and reline the old existing 36-inch pipe at a saving of over $1,000,000 based upon the estimated cost of placing a new line into service. The re-laid main will provide a capacity of 35 m. g. d. of water when required and the City anticipates another century of service from this pipe.

Warren pipe and fittings have been making their contribution to projects and developments for 100 years — literally providing

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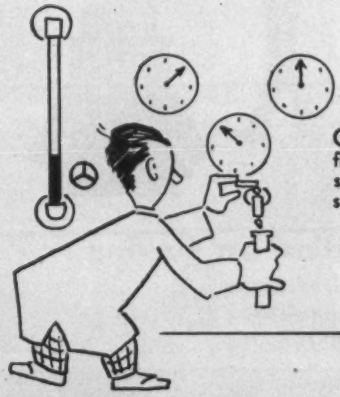
42

THE A.P. SMITH MFG. CO.

EAST ORANGE, NEW JERSEY

TO HELP CONSERVE YOUR WATER SUPPLY

WATER is becoming more scarce, more expensive to obtain, treat, pump and deliver.



CONSERVATION starts with the efficient handling and delivery of water supplies — including meters, meter setting and testing equipment.

THE new Ford Catalog No. 56 is a water man's "bible". It not only pictures and lists the latest in meter servicing equipment, but it contains diagrams and much helpful data for the express purpose of conserving water through more efficient use of meters. It is available on request. Send for your copy today.

FORD

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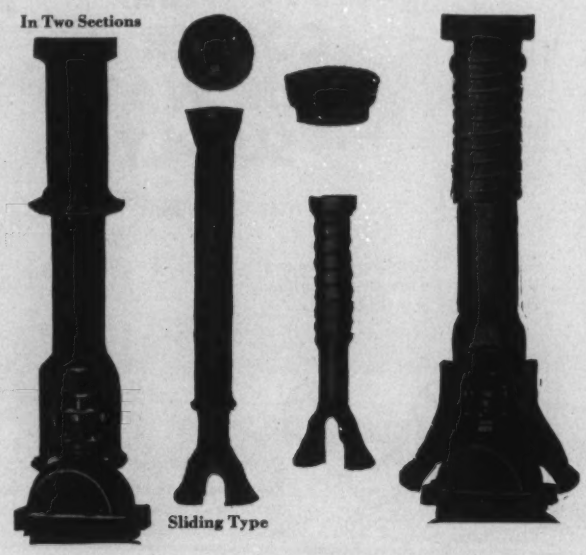
THE FORD METER BOX COMPANY, INC. Wabash, Indiana



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3. *Quick Delivery*

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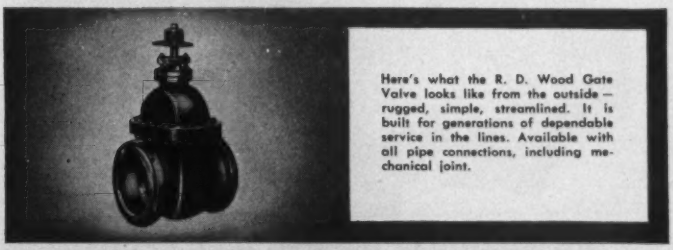
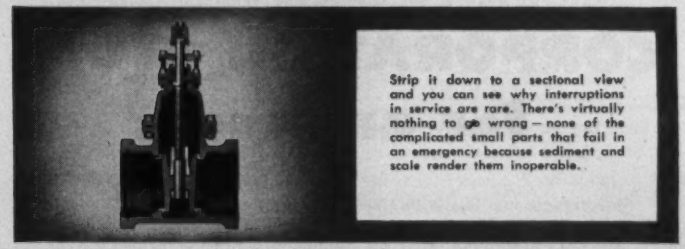
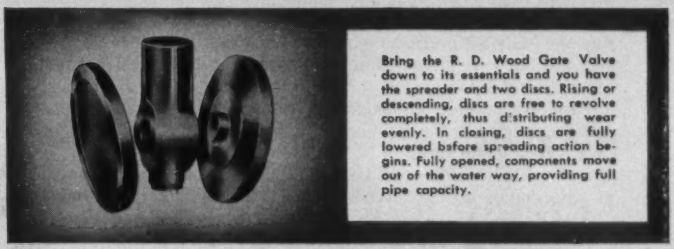
R. D. WOOD GATE VALVES PROVIDE POSITIVE FLOW CONTROL AFTER YEARS IN THE LINES



Here's what the R. D. Wood Gate Valve looks like from the outside — rugged, simple, streamlined. It is built for generations of dependable service in the lines. Available with all pipe connections, including mechanical joint.



Strip it down to a sectional view and you can see why interruptions in service are rare. There's virtually nothing to go wrong — none of the complicated small parts that fail in an emergency because sediment and scale render them inoperable.



Bring the R. D. Wood Gate Valve down to its essentials and you have the spreader and two discs. Rising or descending, discs are free to revolve completely, thus distributing wear evenly. In closing, discs are fully lowered before spreading action begins. Fully opened, components move out of the water way, providing full pipe capacity.

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Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (centrifugally cast in sand molds)

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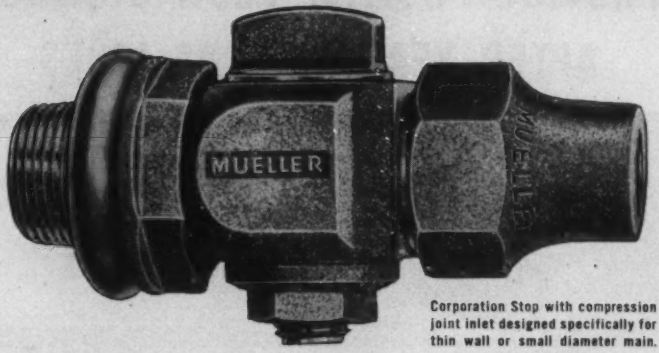

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Wide World Photo

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THIS CITY STREET CAVED IN when a water main broke. It's a dramatic, but not an unusual example of what water does to road bedding.

Protect your roads and pipes from the problems of leakage by Centrilining. This patented process thoroughly cleans and centrifugally lines pipes with cement mortar. Leakage, tuberculation and interior corrosion are permanently checked . . . carrying capacity and distribution pressure are increased to "better than new" highs. And the whole process is done with pipes in place . . . no excavation . . . no traffic disruption.

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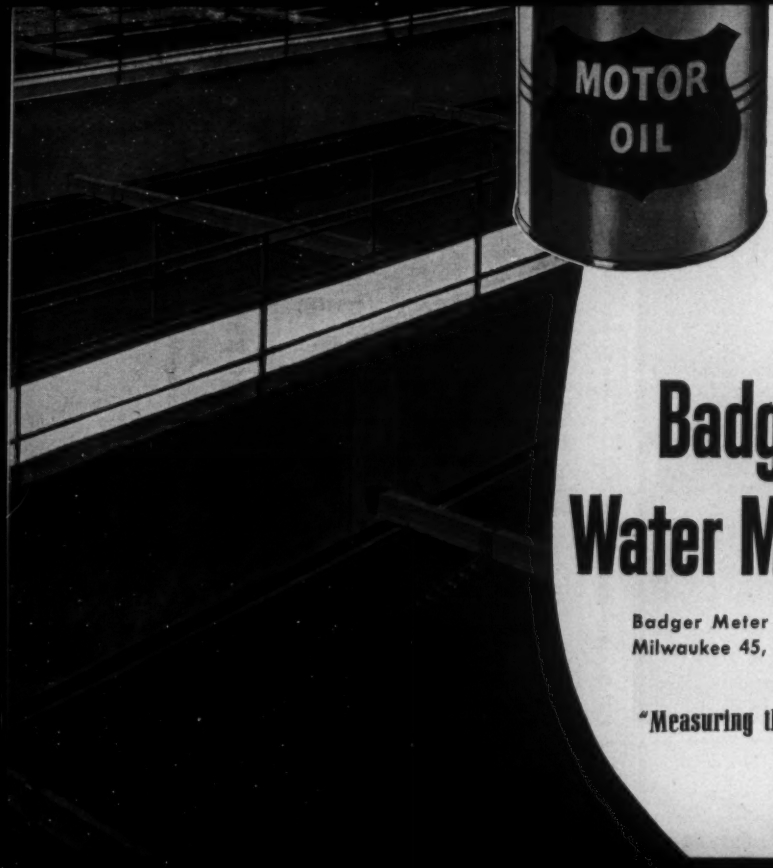
To pinpoint this tremendous volume—more than 4 gallons of water are used in the production of one quart of oil for your automobile.

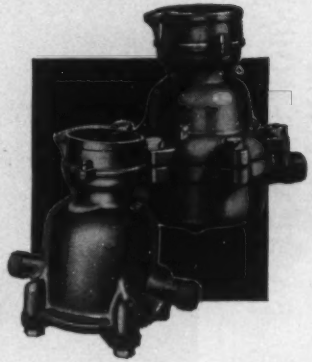
The Badger water meters used throughout the nation help conserve water for this need . . . just as they do for hundreds

Vol.
19



of other essential industries and for vital home usage. They measure water accurately . . . provide a precise check on water consumption and waste . . . serving communities by helping make water departments more efficient and self-supporting.

As the experience of waterworks men everywhere shows, Badger meters do the job dependably . . . are a sound investment that pays dividends year after year.



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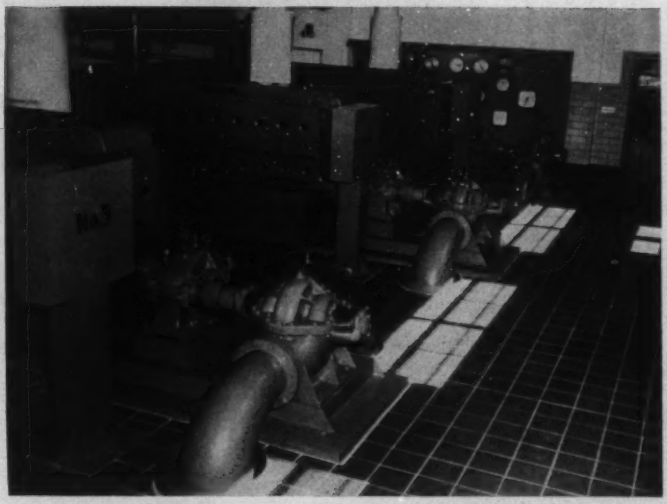

F-M Equipment at the New M.D.C. Newton Street Pumping Station, Brookline

The three Fairbanks, Morse Diesel Engine Driven Pumps pictured above are capable of delivering 4.10 Mgd under present operating conditions into the system of the M.D.C. and the town of Brookline.

Under future conditions, following completion of the Commission's proposed water system lines, the pumps will deliver water at the rate of 5.10 Mgd into the M.D.C.'s Southern Extra-High service lines and into the Bellevue Hill Reservoir.

The design and supervision of this new station for the Water Division of the Metropolitan District Commission was by Coffin & Richardson, consulting engineers of Boston.

The 10″ x 12″ Fairbanks, Morse Figure 5813 Pumps are each driven by a Fairbanks, Morse Model 31A6¼ Diesel Engine.

A trained Fairbanks, Morse Engineer is on hand to help solve YOUR pumping problems.

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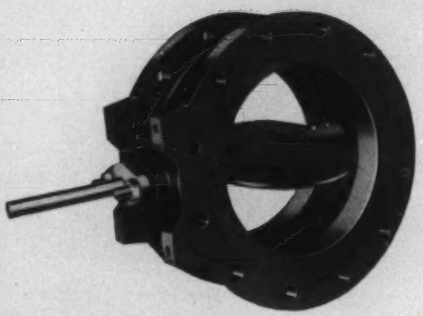

Builders AWWA Standard Butterfly Valves. Engineered specifically for water works service.

The New England Sales Office of B-I-F Industries offers you the most complete line of water works equipment: PROPORTIONEERS feeding and proportioning equipment for solutions — OMEGA volumetric and gravimetric feeders for dry and fluid materials — BUILDERS equipment for recording, indicating, and controlling . . . and for chlorination. We welcome the opportunity to serve you. B-I-F INDUSTRIES, INC., 291 Washington Street, Islington, Mass. Tel.: DEdham 3-5690.

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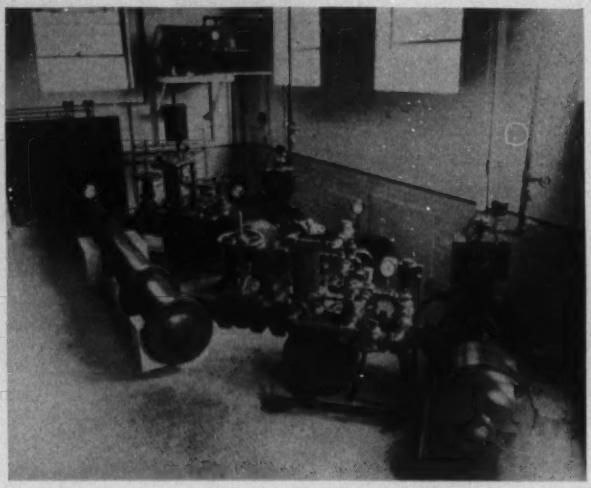

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Duplicate units of 1000 GPM capacity each against 120 feet head are fitted with the DeLaval Submerged Suction Priming System, shown above the top of the pump volutes. This patented system assures positive priming at all times, is fully automatic in operation and provides every possible safeguard for the pumps and the piping. The arrangement shown is but one variation of the DeLaval line of priming equipment which is adaptable to many conditions.

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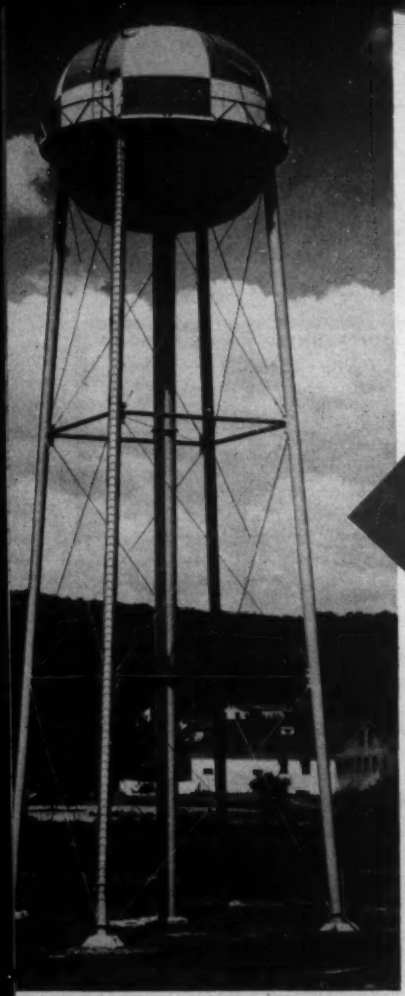

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One hundred thousand gallons, on a hundred-foot tower: that's a most frequent Pittsburgh-Des Moines elevated steel tank specification. And the "100 on a 100" provides top value, too—it is a standard product, handsome in appearance because of fine proportions, but without costly frills. Your community dollar goes a long way with this popular double-ellipsoidal, low head range design. Let us give you the comparative facts, and consult on your water storage requirement.

A variety of P-DM tank types are detailed in our "Modern Water Storage" Catalog. Write for your free copy.

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New England Water Works Association

ORGANIZED 1882

VOL. LXIX DECEMBER, 1955 NO. 4

This Association, as a body, is not responsible for the statements or opinions of any of its members

PROCEEDINGS

SEVENTY-FOURTH ANNUAL CONVENTION

LAKE PLACID, N. Y.

SEPTEMBER 19-21, 1955

The Seventy-Fourth Annual Convention of the New England Water Works Association was held at the Lake Placid Club, Essex County, N. Y., on September 19, 20 and 21, 1955.

MONDAY, SEPTEMBER 19

Morning Session

President Roger G. Oakman in the Chair.

The Annual Reports of the Secretary, Treasurer, Editor, Finance Committee, Committee on Membership, Committee on Legislation, and Committee on Reciprocal Relations with the Institution of Water Engineers were presented and accepted.

The President declared the polls closed and appointed as tellers Sydney C. Beane, John J. Murphy and Samuel G. Wylie.

The following reports of technical committees were presented and accepted: Committee on Survey of Ground Water Supplies in New England, Committee on Water Quality and Treatment, Committee on Specifications for Cast-Iron Pipe and Fittings, Committee on Reinforced Concrete Pressure Pipe, Committee on Specifications for Steel Pipe, Committee on Standardization of Pipe Flanges and Fittings, Committee on Steel Standpipes and Elevated Tanks, Committee on Fluid Permeability, Committee on Deep-Well Vertical Pumps, and Committee on Conservation, Development and Utilization of Water Resources. All formal reports are published in this issue of the JOURNAL.

The report of the Temporary Scholarship Committee was also presented. After much discussion, it was VOTED that the report of

the Scholarship Committee be returned to the committee for further study and report not earlier than the January meeting nor later than the March meeting; that the Association endorses in principle the establishment of a New England Water Works Association scholarship, and that the present committee be continued in existence for the fulfillment of its functions, both as originally outlined and under the terms of this motion.

Secretary Knox announced the election by the Executive Committee of the following new members: Jamil Ahmed Nasir, Manager and Engineer, Jerusalem Water Department, Jerusalem, Jordan; Walter L. Norrington, President, Smith & Norrington Engineering Corp., Boston, Mass.; Vernon Loring Packard, Public Works Administrator, Billerica, Mass.; Irving B. Smith, Vice-President and Treasurer, Smith & Norrington Engineering Corp., Boston, Mass.

Corporate Member

West Bridgewater Water Commission, West Bridgewater, Mass.

Associate Member

Glenfield & Kennedy, Inc., New York, N. Y.

Afternoon Session

A paper on "New Pumping Facilities at Brookline, Massachusetts, for the Metropolitan District Commission" was read by John C. Adams, Jr., Hydraulic Engineer, Coffin and Richardson, Boston, Mass.

A paper on "Water-Supply Improvements and Distribution Problems at Holden" was read by Philip W. Hammond, Superintendent, Water and Sewer Department, Holden, Mass.

A sound film in color, "A New Standard of Precision in Microfiltration and Analysis," was presented by the Millipore Filter Corp., Watertown, Mass.

Evening

Fun, favors and refreshments were enjoyed in the Agora Conference Hall, under the sponsorship of the Water and Sewage Works Manufacturers Association.

Tuesday, September 20

Morning Session

A panel discussion on "Diesel Power for Pumping" was led by Francis J. Turnbull, Consulting Engineer, Fay, Spofford and Thorndike, Boston, Mass. Papers were read by the following: Francis J. Turnbull; Vinton O. Harkness, Manager, Diesel Engine Dept., Fairbanks, Morse & Co., Boston, Mass.; James W. Reilly, Superintendent, Water Department, Ware, Mass.; and Walter N. Westland, President, Cummins Diesel of New England, Inc., Boston, Mass.

Afternoon Session

Owing to the inclement weather the program scheduled for Wednesday afternoon was brought forward to this day.

A paper on "Recent Observations of Water-Works Practices in Europe" was read by E. Sherman Chase, Partner, Metcalf & Eddy, Boston, Mass.

A paper on "An Approach to Water-Supply Toxicology" was read by Benjamin C. Nesin, Director of Laboratories, Department of Water Supply, Gas and Electricity, New York, N. Y.

Wednesday, September 21

Morning Session

A paper on "Realistic Limitations of Flow-Measurement Tolerance and Rangeability" was read by Leland K. Spink, Engineer in Charge of Flow Measurements, and Richard C. Tamm, Product Engineer, the Foxboro Co., Foxborough, Mass.

A paper on "Integrated Equipment for Water-Works Operation" was read by Henry M. Mautner, New England Sales Manager, B-I-F Industries, Islington, Mass.

A sound film in color, "Water—Wealth or Worry for America," on a timely subject of national importance—Water Conservation and Supply—was presented by Cast Iron Pipe Research Association, Chicago, Ill.

Evening

A social hour in the Agora Conference Hall, followed by a banquet in the main dining-room of the Club, was sponsored by the Water and Sewage Works Manufacturers Association.

AWARD OF THE DEXTER BRACKETT MEMORIAL MEDAL

PRESIDENT OAKMAN. At this time I am going to call on Mr. Edwin M. Howard, Chairman of the Dexter Brackett Memorial Medal Award Committee and the Commemorative Award Committee, who will make the presentations.

EDWIN M. HOWARD. Mr. President, members of the New England Water Works Association, and guests: In 1916 the New England Water Works Association established the Dexter Brackett Memorial, to honor the memory of one who contributed so greatly to the water-works profession. Mr. Brackett was affiliated first with the Boston Water Department and later served as Chief of the Distribution System of the Boston Metropolitan Water Supply, and finally as Chief Engineer. He was president of this Association in 1889, and served as editor of the JOURNAL for many years.

This year the committee, consisting of Wayne F. Damon of Leominster, William H. McGuinness of Cambridge, and myself, selected the paper entitled "Deterioration of the Hydraulic Capacity of Pipelines," by Alexander J. Minkus, as the most meritorious paper published in the Journal of the New England Water Works Association in 1954.

Mr. Minkus was graduated from the Massachusetts Institute of Technology with a degree in Sanitary Engineering. He is purification engineer for the Water Bureau of the Metropolitan District in Hartford, Conn., and is also in charge of the transmission mains and emergency supply reservoirs.

Mr. Minkus, it is my pleasure, on behalf of the New England Water Works Association, to present to you the Dexter Brackett Memorial Medal, and I offer you my personal congratulations.

ALEXANDER J. MINKUS. Thank you, Mr. Howard.

Mr. President, members of the Association and guests: Most of the jobs which come to us to do have to be done in a hurry and we are supposed to do them that way. That is our job. But occasionally we get a job assignment that is a little more attractive, which

involves a personal interest. I apparently had a job with a little more than the routine interest and it certainly came out a lot better than I hoped for.

The Memorial Award is something that is an honor to receive, and I certainly consider it as such and deeply appreciate it—especially when I look over the list of previous members of this Association who have received it. I thank you.

COMMEMORATIVE AWARD

EDWIN M. HOWARD. Ladies and gentlemen, the next presentation tonight is that of the Commemorative Award. This Award was established by the Association in 1949, in memory of members who have been prominent in the several fields of the water-works profession, and the purpose of the award is to give due recognition to the paper which is judged second in merit to the one receiving the Dexter Brackett Memorial Medal.

This year the award is in memory of X. Henry Goodnough, who was chief engineer of the Massachusetts Department of Public Health for 35 years. Mr. Goodnough joined the Association in 1891 and was an active and interested member until his passing in 1935. He was elected to Honorary Membership in 1927. Mr. Goodnough was the author of seven papers which were published in the Journal of the New England Water Works Association.

Mr. Kenneth F. Knowlton, Superintendent and Chemist of the Salem-Beverly Water Supply Board, is the recipient of the Commemorative Award this year for his paper, "Investigation of the Continuous Recording of Fluoride Concentration in Water."

Mr. Knowlton, it is my privilege to present to you this Commemorative Award.

KENNETH F. KNOWLTON. It is an extreme pleasure to receive an award from this Association. One of my first acts upon coming into the water-purification field was to fill out a membership application blank for the New England Water Works Association, and I shall never be able to forget the help that the members of this Association in the past several years have given to me in the performance of my duties. Possibly in doing my job I have also helped some of the other members of the Association—I like to think of it that way. The men who have gone before us have done a very fine job. Mr. Goodnough's passing, incidentally, was in the same year in which I graduated from college. I think that some of the fine work which he has done can be carried along by some of us in the future.

Thank you very much.

PRESIDENT OAKMAN. At this time I should like to present the Twenty-Five-Year Award Certificates to the men who have served the same municipality for twenty-five years and who have been members of this Association for the same length of time. The recipients this year are Richard Dillon, of Hartford, Conn., William B. Duffy, of North Andover, Mass., and Fred E. Smith, of Cambridge, Mass. Will those who are here come forward at this time?

Mr. Duffy, it gives me great pleasure to present to you this award.

WILLIAM B. DUFFY. Thank you.

PRESIDENT OAKMAN. The other certificates will be mailed to the men.

An innovation, established this year, is a recognition of the services of those who have held the office of President of this Association. I am going to ask the following recipients to come forward to receive a certificate as the name of each is called:

E. Sherman Chase, who served as President during 1933 and 1934; Roger W. Esty, who served as President from 1935 to 1936; Percy A. Shaw, who served as President during 1939 and 1940; Harold W. Griswold, who served as President from 1945 to 1946; Donald C. Calderwood, who served during 1947 and 1948; Sidney S. Anthony, who served in 1949 and 1950; Thomas R. Camp, who was president during 1950 and 1951; Frederick O. A. Almquist, who served in 1951 and 1952; Stanley M. Dore, who served during 1952 and 1953; William B. Duffy, who served as President last year.

You might be interested in knowing how these certificates read:

> "The New England Water Works Association hereby expresses its sincere appreciation to William B. Duffy for his services as President during 1953-1954."

That is signed by the Secretary and by the President, and endorsed with a gold seal.

Now comes the time when the President has to perform a painful duty; he has to give the presidential address.

PRESIDENTIAL ADDRESS

By Roger G. Oakman

This annual convention marks the closing of a very successful and busy year for the New England Water Works Association.

Much of the credit for the success of this Association goes to the work and co-operation of the members with the work of the various committees. I wish to mention the splendid work and help given by our Secretary, Joseph C. Knox, and his assistant, Mrs. Alice Melrose.

I should like to mention by name Kenneth F. Knowlton, Chairman of the Technical Program Committee, and his assistants, Kenneth W. Robie, who handled the Superintendents' Sessions, and Clarence H. Reed, Chairman of the Chemists' Round Table. These men, along with the rest of their committee, certainly rounded out a full program that was of particular interest to the superintendents, chemists, engineers and other water-works officials.

This Association has continued to grow and we now have a membership of 1,102, which represents a gain of 20 over last year.

After considering the recommendation of Past-President William B. Duffy, by a vote of the Association, a committee of five members was appointed by the President to submit a report on a New England Water Works Association Scholarship Fund to be put into operation. The committee recommended that an Association-sponsored scholarship, to be known as the New England Water Works Association Scholarship, be established. Action on this report, taken at Monday's business meeting, was to refer this report back to the committee for further study and consideration, to report on the same by the March, 1956, meeting.

An innovation was the awarding of a Past-President's Certificate, as witnessed here tonight. Each living past-president of the Association was and will be presented with a certificate in appreciation of his services as President of the New England Water Works Association, upon his retirement from office.

As many of the members know, this Association in the past few years has been operating on a deficit budget. The Finance Committee recommended in their report that the Executive Committee take appropriate action for an increase of the dues of the Association, commencing September, 1956, in order that the income received might meet the amount of the expenditures.

Again I wish to thank the members of the Executive Committee for their help and co-operation in running the affairs of this Association.

I wish especially to thank the Water and Sewage Works Manufacturers Association for their large part in contributing to the success of our June Conference and now this annual convention.

* * * * *

PRESIDENT OAKMAN. Now I am going to call for a report from the Tellers of the Election. I shall call on Sydney C. Beane, who is Chairman of the Tellers.

REPORT OF THE TELLERS OF ELECTION

FOR PRESIDENT: Allan F. McAlary	393 votes—	7 blanks
FOR VICE-PRESIDENT: George G. Bogren	395 votes—	5 blanks
FOR DIRECTOR: Warren A. Gentner	390 votes—	10 blanks
FOR TREASURER: William P. Melley	393 votes—	7 blanks

Total ballots cast, 400.

Respectfully submitted,

(*Signed*) SYDNEY C. BEANE, *Chairman*
JOHN J. MURPHY
SAMUEL G. WYLIE

PRESIDENT OAKMAN. You have heard the report of the Tellers; let us welcome our new officers. [*Applause.*]

At this time I should like to introduce to you Mr. McAlary. [*Applause.*]

Allan, it certainly gives me a great deal of pleasure to welcome you as President of the New England Water Works Association, and I hope that you will get as much joy, and as much help and co-operation from the members, as I have.

PRESIDENT ALLAN F. MCALARY. Officers of the Association, members and guests, ladies and gentlemen: I suppose there are those in this room who could stand up here and take this thing right in stride, but I am just not built that way. I am stirred up just a little bit about it. I appreciate your vote, your confidence. I am more than a little bit proud about it. That is the way I feel about it. However, the passing of a gavel from one President to another is symbolic; it is a token. But there is more involved than just that. That is the way I like to think about it.

This Association for seventy-odd years has been going on, and this thing has happened year after year, but we must look behind this simple ceremony and, as Roger has said, see what makes this thing click.

The officers, the Executive Committee, all who assist, our office staff, secretaries and assistants, the components of our membership, whether operators, engineers, consultants, or manufacturers, who do so much to keep us going—all of these things are symbolized in my thought with the passing of a gavel from one person to another.

I want to congratulate President Roger Oakman on his successful year. There is very little to say. You will be seeing me from time to time during the year, and perhaps I shall save my words until later.

My first duty is a very happy one. As Roger has joined the group of past-presidents, it is my happy duty to present him with this certificate of a past-president.

This announcement is on the program. There will be dancing at the conclusion of this meeting.

Now, after a very happy convention, as we go back to our homes and to our jobs, I trust that you will go back safely and happily, and with that I declare this convention closed.

ANNUAL REPORT OF THE SECRETARY

August 31, 1955

Mr. President and Members of the New England Water Works Association:

The Secretary herewith submits the following report of the changes in the membership during the past fiscal year, and the general condition of the Association.

The present membership is 1,095, constituted as follows: 14 Honorary Members, 906 Members, 138 Associate Members and 37 Corporate Members.

Membership				Total
Sept. 1, 1954—Honorary Members, Total				14
Sept. 1, 1954—Members, Total		897		
Withdrawals:				
Died	9			
Dropped	13			
Resigned	19	41	856	
Elected:				
October 3, 1954	6			
October 22, 1954	2			
November 18, 1954	2			
December 16, 1954	5			
January 20, 1955	6			
February 17, 1955	5			
March 17, 1955	5			
April 21, 1955	8			
May 21, 1955	2			
June 16, 1955	6			
August 19, 1955	3		50	906

Sept. 1, 1954—Associates, Total		136		
Withdrawals:				
Resigned	5	5	131	
Elected:				
October 3, 1954	2			
November 18, 1954	1			
January 20, 1955	1			
March 17, 1955	2			
June 16, 1955	1		7	138
Sept. 1, 1954—Corporates, Total		35		
Withdrawals:				
Dropped	1	1	34	
Elected:				
October 3, 1954	1			
May 21, 1955	1			
June 16, 1955	1		3	37
Sept. 1, 1955—Total Membership				1,095
Sept. 1, 1954—Total Membership				1,082
Gain of				13

Elections

Members

October 3, 1954—Anthony R. Castorina, Blanche A. Dobrzensky, Edward C. Hill, Louis Katona, James C. Lamb, III, and George C. Wallace. (6)

October 22, 1954—Edward Endelson, Richard G. Small. (2)

November 18, 1954—Charles H. Campbell, John V. Richards. (2)

December 16, 1954—Kenneth G. Barnhill, Lorrin S. Brice, Jr., Dale E. Caruthers, Tsuan Hua Feng, Donald R. F. Harleman. (5)

January 20, 1955—John F. Collins, Howard W. Ford, O. Milton Hackett, John S. Lovewell, George L. Pierce, Kenneth H. Walker. (6)

February 17, 1955—Arthur W. Cambridge, James R. Caron, F. Maynard Gifford, Ralph K. Goodwin, Earle L. Pike. (5)

March 17, 1955—Raymond W. Anderson, Walter G. Clark, William F. Fouhey, Russell J. Lutz, John S. B. Morrison. (5)

April 21, 1955—E. Arthur Bell, William Brennan, Constantino J. D'Amato, Alfred S. Doane, Emile H. Fortier, Donald C. Robinson, William H. Taylor, Jr., Howard C. Veit. (8)
May 21, 1955—Warren G. McCrillis, Henry A. Phillips. (2)
June 16, 1955—William F. Duffy, Edward W. M. Dunphy, Thomas O. Elliott, Julian U. Girard, Otto O. Pasanen, Frank J. Saulnier. (6)
August 19, 1955—Ellwood H. Aldrich, Leo D. Coughlin, Horace S. Estey. (3)

Associate Members

October 3, 1954—The Bond-O Company, Millipore Filter Corporation. (2)
November 18, 1954—Aetna Engineering Company. (1)
January 20, 1955—Graver Water Conditioning Company. (1)
March 17, 1955—Angro Painting Service, Simplex Wire and Cable Company. (2)
June 16, 1955—Nelson Meter Service. (1)

Corporate Members

October 3, 1954—Fort Kent Water Company. (1)
May 21, 1955—Millis Board of Water Commissioners. (1)
June 16, 1955—Norwell Board of Water Commissioners. (1)

WITHDRAWALS

Members

Died—Moses N. Baker, Leland G. Carlton, Richard D. Chase, Henry Chisholm, William R. Edwards, Benjamin H. Keeler, Charles F. Knowlton, Samuel D. Soule, William Storrie. (9)

Resigned—Dwight L. Agnew, Nathan C. Avery, Forrest D. Bradshaw, Columbus G. Carley, Harry B. Collins, David Fahlstrom, Carl G. Johanson, Edgar P. Kable, John W. Logan, Elliott J. MacNeil, George M. Mathews, Lloyd W. Nelson, Elbert R. Sherman, Seymour Squires, Edwin J. Titsworth, John K. Van Brunt, Carey A. Walbridge, Ervin L. Welch, Frederick B. Wood. (19)

Dropped—John A. Bellizia, Francis X. Crowley, Blanche A. Dobrzensky, A. V. Garabedian, Wilfred C. Gilbert, Joseph V. Hanbury, Frederick J. Haydock, George E. Keyes, James C. Lamb, III, Miss Regina L. Martineau, Peter E. Pallo, George H. Wile, Sumner J. Weinstein. (13)

Associate Members

Resigned—Crane Company, Davis Tractor Company, Limestone Products Company of America, Magnamatic Corporation of America, Rensselaer Valve Company. (5)

Corporate Members

Dropped—Southboro Board of Water Commissioners. (1)

RECEIPTS FOR THE FISCAL YEAR SEPTEMBER 1, 1954, TO AUGUST 31, 1955

Entrance fees	$ 220.00
Dues, members of all grades	7,793.00
Dividends	530.47
Advertisements	5,241.75
Subscriptions	676.04
Journals	82.29
Membership certificates	21.00
Membership lists	3.75
	$14,568.30

There is due the Association:

Dues	$124.00
Advertising	266.00
	$390.00

Respectfully submitted,

(*Signed*) JOSEPH C. KNOX, *Secretary*

ANNUAL REPORT OF THE TREASURER

Boston, September 9, 1955

To William P. Melley, Treasurer,
New England Water Works Association,
Boston, Massachusetts.

We have examined the statement of assets and funds and the statement of cash receipts and disbursements of the general fund of the New England Water Works Association for the year ended August 31, 1955. Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

We traced all recorded receipts into the depositary bank, verified the general fund bank account and petty cash fund as at August 31, 1955, and examined properly approved vouchers for all disbursements. On September 8, 1955, we examined the paid-up cooperative bank shares at the First National Bank of Boston, and we verified by direct communication the cash on deposit in savings banks.

In our opinion, the accompanying statement of assets and funds and the note thereon and the related statement of cash receipts and disbursements of the general fund present fairly the financial position of the New England Water Works Association at August 31, 1955, and the recorded cash receipts and disbursements for the year then ended, on a cash basis consistent with that of the preceding year.

(*Signed*) SCOVELL, WELLINGTON & COMPANY

STATEMENT OF ASSETS AND FUNDS (Exhibit A)

As at August 31, 1955

Assets

Invested funds assets			
Cash in savings banks			
Boston Five Cents Savings Bank	$ 5,050.00		
Provident Institution for Savings	5,087.97	$10,137.97	
Securities			
Braintree Co-operative Bank, 10 paid-up shares	$ 2,000.00		
Milton Co-operative Bank, 5 paid-up shares	1,000.00		
Sandwich Co-operative Bank, 10 paid-up shares	2,000.00		
Stoneham Co-operative Bank, 10 paid-up shares	2,000.00	7,000.00	$17,137.97
General fund assets			
Cash, First National Bank of Boston		$3,895.56	
In office		50.00	
		$3,945.56	
Furniture and fixtures		1,180.00	5,125.56
			$22,263.53

Funds

Invested funds		$17,137.97
General fund		
Balance, August 31, 1954	$6,032.59	
Add Transfer from invested funds (for Milton Co-operative Bank shares)	2,000.00	
	$8,032.59	
Excess of disbursements over receipts, Exhibit B	(2,907.03)	
Balance, August 31, 1955		5,125.56
		$22,263.53

Note: The statement above, prepared on a cash basis, includes dues received in advance, $5,190, and employees' withholding tax, $134.35. It does not reflect the following:

Accounts receivable, dues	$124
Due on account of advertising	266
	$390

No depreciation has been taken on furniture and fixtures.

STATEMENT OF CASH RECEIPTS AND DISBURSEMENTS (Exhibit B)

For the year ended August 31, 1955

General Fund

Receipts (exclusive of dues received in advance and employees' withholding tax)			
Initiation fees		$220.00	
Dues, 1954-1955 and prior years		2,603.00	
Interest		530.47	
From publication of Journal			
Advertisements	$5,241.75		
Subscriptions	676.04		
Sale of Journal	82.29	6,000.08	
Miscellaneous			
Membership certificates	$21.00		
Membership lists	3.75	24.75	
Total receipts			$9,378.30
Disbursements			
Publication of Journal			
Printing	$4,560.41		
Reprints	52.72		
Reporting	312.12		
Stationery and postage	180.43		
Editor's salary	750.00		
Sundry	43.29	$5,898.97	
General and administrative			
Certificates of membership	$27.30		
Secretary's salary	1,000.00		
Assistant to secretary—salary	3,380.00		
Treasurer's salary	200.00		
Printing, postage and stationery	172.36		
Office supplies and expense	65.67		
Office rent	1,260.00		
Electricity	86.32		
Telephone and telegraph	249.06		
Auditing	85.00		
Social security taxes	158.64		
Printing membership lists	895.83		
Sundry	99.51	7,679.69	
Forward		$13,578.66	$9,378.30

Brought forward		$13,578.66	$9,378.30
Disbursements (continued)			
Meetings and committees			
Water works school	$125.00		
Printing, postage and stationery	1,776.72		
Convention expense	479.25		
Dinners	741.46		
Contribution to June conference	150.00		
Equipment	99.00		
Sundry	385.02	3,756.45	
Interest added to savings bank deposits		137.97	
Total disbursements			17,473.08
Excess of disbursements over receipts (exclusive of dues received in advance and employees' withholding tax for current year)			($8,094.78)
Dues received in advance		$5,190.00	
Employees' withholding tax			
Payment for prior year	$136.60		
Less Receipts for current year	134.35	(2.25)	5,187.75
Excess of disbursements over receipts, Exhibit A			($2,907.03)
Balance, general cash, August 31, 1954		$4,852.59	
Add Sale of Milton Co-operative Bank shares		2,000.00	6,852.59
Balance, general cash, August 31, 1955			
Represented by			
Cash in First National Bank of Boston		$3,895.56	
Cash in office		50.00	
			$3,945.56

ANNUAL REPORT OF THE EDITOR

To the New England Water Works Association:

The Editor submits herewith his report for the year ending August 31, 1955. The financial figures, tabulated in the report, are derived from the report of the Treasurer, which contains a detailed statement of the receipts and disbursements on account of the September and December, 1954, and March and June, 1955, issues of the JOURNAL.

In Table 1 is presented a statement of the material contained in the four issues of the JOURNAL for the past year, while in Table 2 is given a comparison of the JOURNAL for the past year with those for preceding years.

TABLE 1.—STATEMENT OF MATERIAL IN SEPTEMBER AND DECEMBER, 1954, AND MARCH AND JUNE, 1955, ISSUES OF THE JOURNAL OF THE NEW ENGLAND WATER WORKS ASSOCIATION

	Number of pages								
	Papers	Proceedings*	Total text	Index	Advertisements	Cover and contents	Insert plates	Total pages	Total cuts
Sept., 1954	109	5	114	0	47	4	4	169	18
Dec., 1954	0	99	99	6	47	4	0	156	0
Mar., 1955	114	3	117	0	45	4	1	167	17
June, 1955	109	3	112	0	45	4	2	163	12
Total	332	110	442	6	184	16	7	655	47

*Including standard specifications.

Size. The four issues contained 655 pages, of which 442 were text.

Cost. The gross cost of the JOURNAL was $5,898.97, equivalent to $5.42 per member; the surplus was $101.11, equivalent to $.09 per member.

Reprints. Reprints of papers have been furnished to authors at cost.

TABLE 2.—COMPARISON OF JOURNALS OF THE NEW ENGLAND WATER WORKS ASSOCIATION
Four Issues for Fiscal Year Ending August 31

	1946	1947	1948[1]	1949[2]	1950[3]	1951[4]	1952[5]	1953[6]	1954[7]	1955[8]
Average edition (copies printed)	1,200	1,275	1,350	1,325	1,250	1,300	1,390	1,420	1,442	1,476
Average membership	820	846	876	905	921	957	1,017	1,057	1,077	1,089
Circulation at end of year	1,042	1,083	1,129	1,164	1,172	1,240	1,283	1,331	1,334	1,357
Pages of text	391	428	411	452	440	423	463	421	436	442
Pages of text per 1,000 members	477	516	469	500	477	442	456	398	405	406
Total pages, all kinds	586	632	615	661	666	703	671	635	652	655
Total pages per 1,000 members	715	747	702	731	723	734	660	601	606	602
Gross Cost:										
Total	$4,053.08	$4,193.60	$4,239.64	$5,016.44	$5,240.51	$6,069.62	$5,423.98	$5,865.67	$6,108.76	$5.898.97
Per copy	0.84	0.82	0.78	0.95	1.05	1.17	0.98	1.03	1.06	1.00
Per page	6.91	6.63	6.90	7.60	7.86	8.64	8.08	9.23	9.37	9.02
Per member	4.94	4.96	4.84	5.55	5.69	6.34	5.34	5.55	5.68	5.42
Per member per 1,000 pages	8.43	7.85	7.87	8.40	8.55	9.02	7.96	8.75	8.71	8.28
Per member per 1,000 pages of text	12.62	11.58	11.78	12.28	12.92	14.99	11.52	13.19	13.03	12.25
Surplus:										
Total	$162.33	$913.91	$1,990.81	$1,058.96	$1,294.73	$351.34	$1,040.76	$500.97	$513.89	$101.11
Per copy	0.03	0.18	0.37	0.20	0.26	0.07	0.19	0.09	0.09	0.02
Per page	0.28	1.44	3.32	1.60	1.94	0.50	1.55	0.79	0.79	0.15
Per member	0.20	1.08	2.28	1.17	1.41	0.37	1.02	0.47	0.48	0.09
Per member per 1,000 pages	0.34	1.71	3.71	1.77	2.12	0.53	1.52	0.74	0.73	0.14
Per member per 1,000 pages of text	0.51	2.52	5.55	2.59	3.20	0.88	2.20	1.12	1.10	0.20

1Including 54 pages of standard specifications.
2Including 107 pages of standard specifications and recommended practice.
3Including 25 pages of standard specifications.
4Including comprehensive index, 1882 to 1950.
5Including 16 pages of standard specifications.
6Including 87 pages of standard specifications and recommended practice.
7Including 71 pages of standard specifications and recommended practice.
8Including 8 pages of standard specifications.

Circulation. The present circulation of the JOURNAL is:

Members, all grades	1,095
Subscribers	172
Exchanges	23
Advertisers	67
Total	1,357

JOURNALS have been sent to all subscribers and to advertisers.

Respectfully submitted,

(*Signed*) GEORGE C. HOUSER, *Editor*

ANNUAL REPORT OF THE FINANCE COMMITTEE

August 31, 1955

To the Executive Committee of the
New England Water Works Association:

The Finance Committee herewith submits its report on the budget for the year 1954-55, and its recommended budget for the year 1955-56.

The Committee has examined the figures obtained from the records of the Association during the past year, and has consulted with the Treasurer with reference to probable revenue and disbursements during the coming year.

The following changes have taken place in the membership:

	Resigned	Died	Dropped	Elected	Loss	Gain
Members	19	9	13	50		9
Corporates			1	3		2
Associates	5			7		2
	24	9	14	60		13

The following tabulation is the estimated and actual budget for the past year:

REVENUE FOR 1954-1955

	Budget	Actual
Initiation Fees	$ 200.00	$ 220.00
Dues	7,900.00	7,793.00
Interest	450.00	530.47
Advertising	5,700.00	5,241.75
Other Journal receipts	600.00	758.33
Miscellaneous	50.00	24.75
	$14,900.00	$14,568.30

DISBURSEMENTS FOR 1954-1955

	Budget	Actual
General and Administrative	$ 7,400.00	$ 6,786.11
Journal	6,200.00	5,898.97
Meetings and Committees	3,000.00	3,039.49
Net expense of luncheons	900.00	716.96
Membership lists	750.00	895.83
Contingencies	500.00	
	$18,750.00	$17,337.36

The estimated deficit for the past year was $3,850.00 and the actual deficit amounted to $2,769.06.

The disbursements were within the confines of the budget with the exception of the items covering meetings and committees and the membership lists. The amounts were only slightly higher than the prescribed amounts and the total disbursements were well under the figures set forth in the budget.

The Finance Committee has carefully reviewed the Association's finances. For the past several years the expenditures have exceeded the income, and the balance in the General Fund has been materially reduced. Accordingly, the Finance Committee recommends that, effective September 1, 1956, the dues of the Association be increased to provide sufficient revenue to meet annual expenditures.

In setting up the budget for the coming year, the Finance Committee took into consideration the proposal for the establishment of the New England Water Works Association Scholarship. In the event that the report of the Scholarship Committee is acted upon favorably at this meeting, we feel that sufficient funds have been provided under "Contingencies" to meet the expenses of the Scholarship Committee in their fund-raising program.

The Finance Committee has again set up a deficit budget for the coming year.

BUDGET FOR THE YEAR 1955-1956—REVENUE

Initiation Fees	$ 200.00
Dues	8,000.00
Interest and dividends	300.00
Journal advertising	6,000.00
Other Journal receipts	700.00
Miscellaneous	50.00
	$15,250.00

BUDGET FOR THE YEAR 1955-1956—DISBURSEMENTS

General and Administrative	$ 7,500.00
Journal	6,200.00
Meetings and Committees	3,000.00
Net expense of luncheons	900.00
Contingencies	800.00
	$18,400.00

We refer you to the Treasurer's report for further financial details and to the Secretary's report for changes in the membership listing.

Respectfully submitted,

(*Signed*) THOMAS S. LAWRENCE, *Chairman*
JAMES D. HALWARTZ
GEORGE N. WATSON

REPORT OF MEMBERSHIP COMMITTEE

September 16, 1955

To the New England Water Works Association:

During the past year sixty (60) have been elected to membership in the Association with six (6) applications pending, and assuming the six applications are acted upon favorably at the September meeting, the membership will stand at 1,101.

The following is a summary of additions and losses for the year ending September 1, 1955:

Membership, September 1, 1954		1,082
Losses:		
Members resigned	19	
Associates resigned	5	
Members died	9	
Members dropped	13	
Corporates dropped	1	—47
		1,035
New Members		60
		1,095
Applications pending		6
		1,101

Net gain of 19 for the year.

I suggest that the prospective members who were contacted two years ago be invited to join, and that another invitation with the names of the executives for the coming year be prepared and sent to those previously invited.

The several members of the Committee have been most co-

operative in furnishing lists of prospective members and their assistance is appreciated by the Chairman.

Respectfully submitted,

(*Signed*) GEORGE W. COFFIN, *Chairman*
JOHN J. BAFFA
G. ARTHUR FANEUF
HOWARD H. POTTER
FRED P. STRADLING
RICHARD S. WOODHULL

ANNUAL REPORT OF THE COMMITTEE ON LEGISLATION

September 19, 1955

To the New England Water Works Association:

Your Legislative Committee submits herewith its report on activities in the Legislatures of the New England States during the year 1955.

Sessions were held in all six States and your committee member from each submitted one or more enactments deemed worthy of inclusion in this report.

In Connecticut the three most important laws, from a water-supply standpoint, which were enacted during the session are as follows:

(1) Reimbursement to Utilities of Expense Incurred in Connection with State Highway Construction.

The law which was enacted at the 1952-3 session, by which utilities were reimbursed by the state highway department for expenses incurred in relocating their structures necessitated by construction of non-access (thruway) highways, was amended to include all trunk-line state highways.

(2) An Act Establishing a Water Resources Commission.

This act sets up a temporary Water Resources Commission of seven members to study the water resources of the state of Connecticut and the present laws pertaining thereto, and further to study the relative needs of the various groups represented on the commission, with particular reference to the greatest good of the entire people of the state, and to report its findings to the General Assembly on or before January 1, 1957.

(3) A Resolution Concerning a Study of the Recreational Facilities at State Reservoirs.

This resolution, sponsored by the Advisory Council of the Connecticut State Board of Fisheries and Game, empowers the Governor to appoint a committee to gather facts and information regarding the feasibility of making public water-supply watersheds accessible to public fishing, hunting and other recreation, and to report its findings and recommendations to the Governor before July 1, 1956.

The Legislature of the State of Maine enacted into law the following:

Chapter 50—An Act Relating to Record of Proceedings before Public Utilities Commission.

Section 66 of Chapter 44 of the Revised Statutes is hereby amended to read as follows:

Record of Proceedings. A full and complete record shall be kept of all proceedings had before the commission and of any investigation or formal public hearing and all testimony shall be taken by a hearings reporter to be appointed by the commission subject to the provisions of the personnel law.

CHAPTER 186—AN ACT TO EXTEND THE POWER TO SERVE TO PUBLIC UTILITIES ORGANIZED BY SPECIAL ACT OF THE LEGISLATURE.

Section 58 of Chapter 44 of the Revised Statutes is hereby amended by adding at the end thereof the following paragraph:

The Commission may authorize any public utility organized by special act of the Legislature, to furnish or extend its service in, to or through any city or town notwithstanding any territorial limitations, express or implied, in the special act of the Legislature by which it was organized, or in any special act of the Legislature under which it is enfranchised, and the powers and limitations of the Commission, hereby made applicable hereunder, shall be those applicable by law in like cases concerning public utilities organized under the provisions of Sections 8 to 15, inclusive, of Chapter 53. Any public utility organized by special act of the Legislature which is authorized hereunder in respect of service in, to or through any city or town not named in a special act of the Legislature as among the cities or towns to be served by it, shall, within 20 days after final authorization of the Commission as aforesaid, file with the Secretary of State a certificate exhibiting such authorization of the Commission, and thereupon the power to serve as therein provided shall take and be of effect. On filing such certificate there shall be paid to the Secretary of State for the use of the state the sum of $20. Nothing in this section shall be construed to apply to common carriers by railroad which are subject to the jurisdiction of the Interstate Commerce Commission.

CHAPTER 202—AN ACT RELATING TO PUBLIC HEARINGS FOR PUBLIC UTILITIES.

Section 61 of Chapter 44 of the Revised Statutes is hereby amended by adding at the end thereof a new paragraph to read as follows:

Whenever any public utility, except a common carrier or carrier of persons or property for hire, has been notified by the Commission that a public hearing will be held as provided in Section 35 or Section 57 and it appears to the Commission that reasonable publicity has not or will not be given, by newspaper publication or otherwise, of the time and place of said hearing and the general nature thereof, the Commission, in its discretion, may, by written notice to such public utility, require it to give such reasonable notice as the Commission shall specify of the time and place of such public hearing to each of the subscribers affected or to be affected by such rates or service and to file at the same time in the office of the clerk of the municipalities wherein such subscribers reside such pertinent information as the Commission may prescribe as to rates and services involved, including schedules of any proposed rates. Such notice by said public

utility shall be given by first class mail and shall include a statement that such pertinent information as to such rates or service is on file in the office of the clerk of the municipality wherein such subscriber resides. Nothing in this section shall relieve such utility from the provisions of Section 31.

CHAPTER 258—AN ACT RELATING TO CONDEMNATION PROCEEDINGS BY WATER DISTRICTS.

Section 23 of Chapter 52 reads as follows as amended:

Necessity of taking determined. The owner of property which is the subject of appropriation for public purposes by any water district may, upon hearing, have the necessity of the particular appropriation determined by the Public Utilities Commission.

Section 24 revised reads: Proceedings. The owner of such property may, within 30 days after the beginning of condemnation proceedings, file in the office of the clerk of the Public Utilities Commission, a petition to the Commission for a decision as to the necessity of the appropriation. A copy of the petition and order of notice thereon, attested by the clerk, shall be served upon the respondent.

An amendment of Section 25, Chapter 52, relates to the proceedings before the Commissioners.

CHAPTER 298—AN ACT RELATING TO ADVICE OF PUBLIC UTILITIES COMMISSION TO TOWNS CONCERNING WATER AND SEWERAGE SYSTEMS.

The amended sentence of Section 13, Chapter 44, reads:

Cities, towns, water districts, sewer districts and water companies shall submit to said Commission for its advice their proposed new system of water supply or of the disposal of drainage or sewage, prior to solicitation of bids for construction thereof or, if bids are not to be solicited, prior to actual construction thereof, but they shall not be required to submit to the Commission for such advice any proposed repair, alteration, relocation or extension of their existing system of water supply or of the disposal of drainage or sewage.

CHAPTER 451—AN ACT PROVIDING FOR GROUP LIFE INSURANCE FOR STATE EMPLOYEES AND TEACHERS.

This amendment of Chapter 63-A adds three new sections and is too lengthy to be either quoted or described in this report. Your committee suggests that interested members obtain a copy of the Act.

Two private and special enactments, Chapters 48 and 201, relate to prevention of pollution of the waters of Sebago Lake and eminent domain by the Maine Turnpike Authority, respectively.

. . . . .

As of the date of the writing of this report the Massachusetts Legislature is still convened in the second longest session in its history. However, any proposed legislation having a bearing on water-supply matters has been acted on and your committee reports as follows:

CHAPTER 332—AN ACT TO AUTHORIZE THE LEVY OF SPECIAL ASSESSMENTS TO MEET THE COST OF LAYING WATER PIPES IN PUBLIC AND PRIVATE WAYS.

(Chapter 332 is an amendment of Chapter 40 of the General Laws. It does not take effect in any city, town or district having a water-supply or water-distributing system until acceptance thereof by vote of the City Council of any city subject to the city charter or in Plan E cities by vote of its City Council or in towns or districts by vote of its inhabitants at its annual town meeting.)

Chapter 332 of the G. L. Chapter 40, Sec. 42G provides that any city or town having a water-distributing system, after acceptance of this legislation in the manner provided for in Section 42G, may provide for the levy of special assessments to meet all or part of the costs of laying pipes in public and private ways for the distribution of water, such levy to be made against an owner of land who benefits from the laying of such water pipes through the supply of water to his land or buildings; such land owner to pay a proportionate part of the cost, not already assessed, of extending such water supply to his land, said cost to include material, labor and incidental expenses, all as ascertained, assessed and certified by the Water Commissioner or other officer in charge of the supply and distribution of water.

By the same Act, a new Section 42H of Chap. 40 is created, providing that any city or town having a water-distributing system may provide that assessment of the cost of laying water pipes in public and private ways shall be made upon the owners of land receiving benefit therefrom by a fixed uniform rate, based upon the estimated average cost of the pipe and the laying thereof according to the frontage of land on any way in which a pipe is laid or according to the area of such land within a fixed depth from the way or according to valuation for purposes of taxation in the last annual assessment, or according to two or all of the foregoing methods. By the same Act a new Section 42I of Chap. 40 is created, providing that whenever the officer in charge of the supply and distribution of water in any city or town shall have accepted the provisions of Section 42G to 42I inclusive, may determine to lay water pipes in ways and assessments are made pursuant thereto, there shall be recorded in the Registry of Deeds of the appropriate county, a statement of the action of such officer specifying the ways in which the water pipes are to be laid and describing any land which does not abut upon any such way which is to be assessed for the improvement. All assessments imposed under the said section upon any land shall constitute a lien upon such land from the time such statement is recorded. Provisions of Chapter 80 relative to apportionment, division, etc., shall be applicable to such assessments. Any assessment made shall not be in excess of the benefit to the land assessed from the laying of the water pipes on account of which the assessment is levied and if it shall be found to be so, shall be abated. The officer in charge of the water supply of the city, town, etc., shall, after the assessment is made upon land which is not built upon, extend the time of the payment of the assessment and interest thereon at the rate of 4% until it is built upon or for a fixed time, the assessment to be paid within three months after the land is built upon or at the expiration of such fixed period.

CHAPTER 335—AN ACT EXTENDING THE AUTHORITY OF THE DEPARTMENT OF PUBLIC HEALTH TO REGULATE METHODS OF HANDLING AND DISPOSING OF RADIOACTIVE MATERIALS.

Under this enactment, which was passed as an emergency law, Chapter 111 of the General Laws is amended to provide that the subject department from time to time, after a public hearing, and contingent upon the approval of the Governor and Council, shall promulgate rules and regulations regarding the handling and disposal of radioactive materials which may affect the public health or the health of persons exposed to radioactivity. Nothing in these rules and regulations shall be inconsistent with those now or hereafter established by the National Bureau of Standards on this subject.

Of interest to members taking their water supply from the Metropolitan District Commission is:

CHAPTER 419—AN ACT AUTHORIZING AND DIRECTING THE TRANSFER FROM THE METROPOLITAN DISTRICT COMMISSION TO THE CITY OF NEWTON OF UNUSED PARTS OF THE COCHITUATE AQUEDUCT IN SAID CITY, AND TO EMPOWER SAID CITY TO TAKE LAND IN ORDER TO FACILITATE THE UTILIZATION OF ANY SUCH PART OF SAID AQUEDUCT FOR SEWAGE DISPOSAL PURPOSES.

Your Committee wishes to point out that the Legislature passed this Act substantially in the form as recommended by the association of member communities of the Metropolitan Water District, subsequent to conference and vote by the association's representatives, and after completion of negotiations with the Metropolitan District Commission.

The following Resolves were adopted during the 1955 session:

CHAPTER 28—AUTHORIZING THE CONTINUANCE OF AN INVESTIGATION RELATIVE TO THE STUDY OF THE ELIMINATION OR CONTROL OF SUBMERGED WEEDS IN CERTAIN GREAT PONDS OF THE COMMONWEALTH.

CHAPTER 38—RESOLVE PROVIDING FOR AN INVESTIGATION AND STUDY BY A SPECIAL COMMISSION RELATIVE TO THE FUTURE USE OF THE BROOKLINE-NEWTON WATER LANDS.

Worthy of mention simply because it is probably the first time that an investigation of this character has been instituted.

CHAPTER 65—RESOLVE AUTHORIZING AND DIRECTING THE METROPOLITAN DISTRICT COMMISSION TO CONTINUE AN INVESTIGATION AND STUDY RELATIVE TO THE EXTENSION OF THE METROPOLITAN WATER SYSTEM MAINS INTO THE COUNTIES OF PLYMOUTH AND BRISTOL.

CHAPTER 68—RESOLVE REVIVING AND CONTINUING THE SPECIAL COMMISSION ESTABLISHED TO INVESTIGATE AND STUDY GROUND WATER SUPPLIES IN THE COUNTIES OF PLYMOUTH AND BRISTOL.

Your Committee wishes to advise that all eight bills opposed to fluoridation in one form or another were referred to the next annual session.

In New Hampshire there were several stream-classification bills enacted, but the only one of these which might be of interest to the members is Chapter 25, concerning the Pennichuck Brook watershed in the Nashua area. Pennichuck Brook is the source of supply for the city of Nashua and a Class A was adopted for the portion used for water supply. In effect this means that no sewage, treated or otherwise, can be discharged into this water.

Chapter 245 was enacted in this session and requires that any plan for the construction of highways, roads or access ways within watersheds tributary to a public water supply must be submitted to the State Board of Health for approval prior to construction.

Rhode Island

Your Committee member from Rhode Island reports that the General Assembly enacted one piece of legislation of interest to the Association. Chapter 3562—approved April 29, 1955—creates a State Water Resources Coordinating Board. The Act gives the Board the following powers and duties:

Powers.

The Board shall act in an advisory capacity in reviewing and interpreting the data pertaining to the water resources of the state and in studying and advising on area requirements and supplies for present needs and for meeting future demands, all with a view to formulating and coordinating a state water resources program and for integrating, as far as possible, all local and state sponsored plans for conservation and development of the water resources of the state.

Duties.

It shall be the duty of the State Water Resources Coordinating Board:

(A) To review the current studies and work programs of the several state agencies pertaining to the conservation and development of the water resources of the state;

(B) To advise and counsel with local authorities in the formulation of municipal water resources programs with a view to coordinating all water conservation and development plans in an orderly and comprehensive water development program for the state;

(C) To review and evaluate the ground water investigations carried on by the state with a view to formulating a long-range plan for protecting and preserving the areas having a potential surplus supply;

(D) To assist in devising and perfecting ways and means for accommodating the distribution of the water supplies of the state.

Vermont

Legislation passed by the 1955 Vermont Legislature did not include any laws which have a direct effect on water-supply systems. A few of the laws, however, may have an indirect relationship to watershed areas for water departments.

Act No. 234 is intended to enable state participation in the watershed-protection and flood-prevention act, public law No. 566, as passed by the 83rd U. S. Congress. This law gives the Vermont Water Conservation Board authority to carry out programs for flood control and to negotiate and enter into contracts for construction of dams for flood-control purposes, structures for stream-bank protection or for improvements of stream channels.

Act No. 241 amends the 1951 legislation relating to Social Security coverage for state and municipal employees. A new section was added to this law, providing for a referendum. Employees of a political sub-division are allowed to express their desires for such a referendum concerning Social Security coverage.

Act No. 267 amends existing legislation concerning the establishment of fire districts and of changes in boundaries of such fire districts. In Vermont a fire district is a political sub-division within a town. It has the powers and responsibilities of municipal corporations. Such a fire district may establish a water system, issue bonds, collect taxes, etc.

Respectfully submitted,

(*Signed*) MARK F. CROKER, *Chairman*
WARREN A. GENTNER
WILLIAM A. HEALY
PHILIP J. HOLTON, JR.
PETER C. KARALEKAS
EDWIN T. MCDOWELL
EDWARD L. TRACY

REPORT OF COMMITTEE ON RECIPROCAL RELATIONS WITH THE INSTITUTION OF WATER ENGINEERS (LONDON)

The Committee on Reciprocal Relations with the Institution of Water Engineers was established as a result of a suggestion made about twenty years ago by Mr. Harold Gourley, Consulting Engineer, in London, who presented a paper at our 1935 Convention in New York. On his return home he wrote, suggesting that such a committee be formed in each of the two associations, the object of which was to foster cordial relations and the exchange of information between two organizations having similar objectives.

One of the ways to secure these objectives was for each association to submit to a committee of the other association at alternating two-year intervals outstanding papers prepared and presented by its members during the previous four years. From these papers, one would be selected for an award in the form of a diploma of merit and would be published in the journal of the association to which it was submitted.

A committee of your association was formed shortly after Mr. Gourley's letter was received, consisting of Leland Carlton, Percy Shaw and myself. The membership of the committee remained as I have stated until Mr. Carlton resigned not very long before his untimely death. Subsequently Donald Calderwood of Nashua was appointed to succeed Mr. Carlton. The membership of the committee now consists of Donald C. Calderwood, Percy A. Shaw and myself.

This year, at the summer meeting of the Institution of Water Engineers, which was held at Richmond late in May, I had the opportunity of presenting our diploma to Mr. Alan Atkinson, water engineer of Manchester, for his paper given two or three years ago upon cleaning and relining water mains in the ground.

One of the reasons that your committee selected that particular paper was because it seemed to us that his experience was something

that would be of real interest and real value to us in the New England area, where we have some waters which are extremely corrosive and where our water mains lose carrying capacity, due to the tuberculation resulting from the corrosion.

This paper has not as yet been published in our JOURNAL, but I assume that it will be, and I think it is something that you will find of considerable interest.

Your committee has currently submitted to the Institution of Water Engineers a list of four papers which have appeared during the last four years in our JOURNAL for the Institution's corresponding committee to select the one which they consider the most worthy of the Institution's diploma. Presumably this paper will be published in the Journal of the Institution in due course of time. What particular paper the committee of the Institution will select I have no way of knowing.

Three or four of our members have already received diplomas from the Institution—Stanley Dore, Gordon Fair, Karl Kennison, and I think perhaps one or two more; I am not sure just who.

Inasmuch as I was going to be present at this May meeting of the Institution, your President Oakman and Secretary Knox wrote a cordial letter to the members of the Institution, which I had the privilege of presenting. The expressions of high regard which were contained in this letter were very well received, and the July Journal of the Institution on one of its pages contains a facsimile of the letter, with the seal of the New England Water Works Association and the signatures of Mr. Oakman and Mr. Knox.

Respectfully submitted,

(*Signed*) E. SHERMAN CHASE, *Chairman*

REPORT OF COMMITTEE FOR SURVEY OF GROUND WATER SUPPLIES IN NEW ENGLAND

September 16, 1955

This is a progress report of the Committee for survey of public ground waters in New England. To date completed questionnaires have been received from four of the six New England states, representing approximately 75% of the population of the entire area.

A brief analysis of the tabulations as received indicates an increase of about 5% in the number of well installations since previously reported by this Committee in 1949.

As a matter of interest it might be noted that well installations made since 1949 fall into the following types:

58%	were gravel-packed
1%	were gravel-developed
36%	were driven wells
3%	were dug wells
1%	were springs
Less than 1%	were deep wells in rock

Following the receipt of all information the Committee proposes to submit a detailed report, along with all tabulations of pertinent information regarding individual sources of public supply.

Respectfully submitted,

M. L. Brashears, Jr.
H. N. Halberg
H. H. Potter
W. J. Shea
L. K. Sherman
R. M. Soule
H. J. Steinhurst
E. L. Tracy
(*Signed*) F. J. Lariviere, *Chairman*

REPORT OF THE COMMITTEE ON WATER QUALITY AND TREATMENT

To the New England Water Works Association:

This committee assumes that its proper function is to keep the membership of the Association informed on current developments in water treatment, and on current thinking about water quality. It happens that the chairman of the committee is also chairman of the subcommittee on Water Supply of the National Research Council, under the Committee on Sanitary Engineering and Environment of the Council's Division of Medical Sciences. It is the duty of this subcommittee to advise the Armed Services and other agencies of the Federal Government on water supply. Some of the questions recently raised by these agencies are of general interest, and it is believed that an account of the deliberations of the sub-committee on them would be useful to the membership of this association.

Chlorine and Chlorination

The Surgeon General of the Army requested the National Research Council to give recommendations for the minimum chlorine residuals to be carried in water supplies for the Armed Services. After collecting and digesting all reliable experimental evidence, the sub-committee issued a report which is scheduled for publication in the near future. The report attempts to specify minimum 30-minute residuals, for free chlorine and chloramine, under all conditions of pH and temperature likely to be encountered. Where only bacteria are present, the recommended free chlorine residuals for all temperatures from 0-25°C. are 0.2 mg/l up to pH 9.3, 0.3 mg/l at pH 9.5, 0.6 mg/l at pH 10.0 and 1.0 mg/l at pH 10.5. The rise is due, of course, to the conversion of a large part of the hypochlorous acid to hypochlorite ion at the higher pH values. Actually, complete bacterial kills are secured at 0.05 mg/l at pH 6.5 and 0.06 mg/l at pH 7.0, but insistence on a minimum residual of 0.2 provides a

safety factor deemed necessary in military operations. For ammonia chloramines* the recommended 30-minute residuals at 0 to 25°C. begin with 2.3 mg/l at pH 7.0 and rise slowly to 3.4 mg/l at pH 10.5. Chloramine disinfection is not so adversely affected by high pH as free chlorine disinfection. For both free chlorine and ammonia-chloramine disinfection the effect of temperature is comparatively small if only bactericidal residuals are considered.

If cysts of Endamoeba histolytica may be present in the water, the requirements for free chlorine residuals are greatly increased, and those for ammonia chloramines are so large as to be of no practical importance. For example, the required 30-minute residual for complete kill of cysts at pH 6.0 is 2.0 mg/l at 22-25°C., and 7.5 mg/l at 2-5°C. These values increase with pH; they are 2.5 and 10.0 respectively at pH 7.0, and 5.0 and 21.0 at pH 8.0. It is interesting to note that the Army routinely used a 5-mg/l free chlorine residual for all waters in Korea, and this was done without great protest on the part of the consumers, or any evidence of physiological effect. The Army authorities were, in this case, less concerned with amoebic cysts than with the virus of infectious hepatitis. Our knowledge of the persistence of viral agents in water in the presence of disinfecting agents is almost negligible, but such information as exists indicates a resistance to these agents somewhere between that of bacteria and that of the amoebic cysts.

* * * * *

The Department of Civil Defense requested the sub-committee to determine how great a concentration of chlorine can be consumed in water without physiological damage. The obvious purpose here is the control of biological warfare agents that might be introduced into water supplies. The sub-committee was surprised to find that no sound toxicological data existed to answer this question. This gap in our knowledge is being remedied as rapidly as possible. Meanwhile, all instances where persons are known to have consumed large quantities of chlorine have been recorded and analyzed. For example, in certain locations during the 1951 Kansas River floods, the water

*These values are for chloramines already formed, and do not necessarily apply to the separate addition of chlorine and ammonia.

mains were heavily disinfected with chlorine. Despite warnings, many people continued to drink the water, and concentrations of 50, 60, and even 75 mg/l were consumed without any evidence of physiological effects. Similar observations were made in Golconda, Ill., during the Ohio River flood of 1937.

Such observations do not, of course, furnish a sound toxicological base for advocating, or even permitting, the continued consumption of water containing chlorine concentrations of this magnitude. However, it is certain that quite large concentrations of chlorine can be consumed for short periods in an emergency. A preliminary report on toxicological studies in progress indicates that mice, that have consumed water containing 200 mg/l of chlorine as their sole supply for one month, show no ill effects.

* * * * *

In response to a query as to whether all water utilities should maintain a chlorine residual throughout the entire distribution system, to serve, for example, as a warning agent against the secret introduction of biological agents, the sub-committee, after some deliberation, concluded that this was inadvisable for the ordinary water system.

Membrane Filter for Coliform Determination

The membrane-filter technique for the determination of the coliform content of water has features which make it very attractive for military use. One of these features is a considerable reduction in the time required for the determination, as compared with that required for the standard method. Another is a modification of the technique which permits shipment of the membrane, in contact with a pad containing a holding medium, back to a central laboratory for incubation and counting; this eliminates the necessity for shipment of water samples, with the attendant nuisance of providing for cooling during transit.

Statistical analyses of three very extensive laboratory comparisons of the membrane-filter method with the standard fermentation-tube (MPN) method have yielded results favorable to the membrane-filter method. The precision of the membrane-filter method appears,

from these studies, to be considerably superior to that of the usual 5-5-5-tube fermentation test. The disparities between the membrane-filter and the fermentation-tube values for individual water samples are not larger than the disparities between results obtained with the permissible variations of the standard fermentation-tube method. Furthermore, when allowance is made for the mathematical bias of the MPN, which tends to be 23% too high in a 5-5-5-tube test, for example, the recovery of coliforms appears to be substantially the same for both methods. For this reason, the National Research Council's Committee on Sanitary Engineering and Environment has endorsed the development of membrane-filter techniques for use by the Armed Services.

Filtration Rates in Rapid Sand Filters

Because of progressive improvement in the techniques of pretreatment of water, notably in coagulation and preliminary disinfection, it has become possible to increase rates of filtration through rapid sand filters above the commonly-accepted two gallons per square foot per minute. In many well-operated municipal plants, the filters actually do little of the work of purification; sometimes nearly sterile water has been put on the filter and has been actually degraded in bacteriological quality by filtration. A number of papers have been published on filter operation at high rates, and recent plant designs have shown a trend toward increasing the 2-gpm rate to 3 or more gpm. The sub-committee is endeavoring to decide whether water-supply practice for the Armed Services should follow this trend, or whether the lower filter rates should be preserved as a safety factor, in view of the greater operating difficulties that may be experienced in military water supplies.

Allowable Coliform Loadings for Water-Treatment Plants

The U. S. Public Health Service has begun a comprehensive re-examination of its suggested values for the allowable coliform content of raw waters entering water-treatment plants. The work upon which these values were based is now over 20 years old, and many advances in water-purification practice have been made in that time.

The study will commence with the collection and analysis of data from plants in operation in various parts of the country, using many different kinds of raw water. The Service is particularly anxious to secure data for waters that contain some coliforms and are treated by chlorination only; the suggested value of 50 coliforms per 100 ml for this type of treatment is very insecurely based.

The analysis of operating data may eventually be followed by studies of a pilot-plant unit, operating under careful control over a wide range of conditions. It is probable that the outcome of the study will be a substantial increase in the allowable raw-water coliform maxima for all types of treatment.

Most of the steps in water purification, particularly disinfection and coagulation, are better understood and much improved in practice over what they were in the days when the suggested coliform limits were determined. Many plants now produce satisfactory finished waters from raw waters which are frequently far in excess of the suggested maxima.

Respectfully submitted,

(*Signed*) EDWARD W. MOORE, *Chairman*
GEORGE G. BOGREN
EDWARD S. BROWN, JR.
CLAIR N. SAWYER
WARREN J. SCOTT
DAVID H. TURCOTTE

REPORT OF COMMITTEE ON SPECIFICATIONS FOR CAST-IRON PIPE AND FITTINGS

September 19, 1955

To the New England Water Works Association:

Your representatives on Sectional Committee A-21 of the American Standards Association on Specifications for Cast-Iron Pipe and Fittings (which is N.E.W.W.A. Committee 21) offer the following report.

As previously reported a year ago, the active work of this committee has been largely completed. It has therefore been recently decided to reorganize the committee, to put it on a stand-by basis for the purpose of making revisions of existing cast-iron pipe specifications from time to time as needed, and to deal with other new matters which may be referred to it.

The reorganization provides for a substantial reduction in the membership. As a result, N.E.W.W.A. representation is cut from two to one. Provision is made, however, for temporarily expanding the technical subcommittees, which may be set up for any special purpose, by appointments outside the basic committee from associations or individuals having particular interest in, or knowledge of, the work in hand.

While Committee A-21 will be comparatively inactive, it is believed to be important that N.E.W.W.A. be kept in touch with such transactions as may occur through the single representative which the N.E.W.W.A. Executive Committee will presumably designate when committees are appointed for the ensuing year.

Respectfully submitted,

(*Signed*) RICHARD HAZEN
ARTHUR L. SHAW

REPORT OF THE COMMITTEE ON SPECIFICATIONS FOR STEEL PIPE

September 19, 1955

To the New England Water Works Association:

This Committee of your Association acts jointly with Committee E7A of the AWWA on specifications for steel water pipe. At the annual meeting of Committee E7A on June 14, 1955, the Steel Water Pipe Manufacturers' Technical Advisory Committee reported progress on specifications for the dimensions of steel water-pipe fittings, recommended revising Specifications C201 and C202 to change the grade of steel plate, reported progress on combining Specifications C203 and C204 on coal-tar enamel protective coatings, recommended minor revisions in Specifications C203 and C204 to bring them up to date, reported the formation of a new subcommittee on plastic and other protective coatings for steel water pipe, and reported progress in the development of a Steel Water Pipe Manual.

The Committee appointed to investigate the Taylor Forge and Pipe Works request for inclusion of their lap spiral-welded steel pipe in AWWA pipe specifications submitted its report at the annual meeting of Committee E7A, and the whole subject was referred back to the Committee for further investigation and report. Committee E7A approved the minor changes recommended in Specifications C203 and C204 by SWPMTAC. A committee was appointed to prepare specifications on cement-mortar protective coatings for steel water pipe of all sizes as a revision of the existing specification C205.

Respectfully submitted,

(*Signed*) THOMAS R. CAMP, *Chairman*
CHESTER J. GINDER

REPORT OF THE COMMITTEE ON STANDARDIZATION OF PIPE FLANGES AND FITTINGS

September 19, 1955

To the New England Water Works Association:

Sectional Committee B-16 of the American Standards Association dealing with Pipe Flanges and Flanged Fittings (N.E.W.W.A. Committee 26) has been active during the past year, but on matters having no more than passing interest for water-works people.

Specification B16-20 for Ring-Joint Gaskets and Grooves has been approved as an American Standard.

Tentative revisions of specifications B16-18 for Cast-Brass Solder-Joint Drainage Fittings have been circulated; this specification is now several years old and advances in the art have made desirable the revisions in details to be covered by a new specification, to be known as B16-23.

The scope of Committee B-16 includes designation of materials and pressure-temperature ratings of pipe flanges, pipe and tube fittings and valves; and standardization of dimensions for pipe flanges, pipe and tube fittings, and face-to-face and end-to-end of valves. It is worthwhile to continue N.E.W.W.A. representation on this committee, in order to be promptly informed of matters which might prove to be of importance in water-works practice.

Respectfully submitted,

(*Signed*) RICHARD HAZEN
ARTHUR L. SHAW

REPORT OF COMMITTEE ON STEEL STANDPIPES AND ELEVATED TANKS

June 22, 1955

To the New England Water Works Association:

The NEWWA approved "Standard Specifications for Steel Tanks, Standpipes, Reservoirs, and Elevated Tanks for Water Storage," as revised by a Joint Committee of the AWWA, AWS and NEWWA, on September 14, 1948. The Joint Committee has made extensive revisions and additions from time to time. On May 9, 1952, the changes then recommended by the Joint Committee were approved by the NEWWA Executive Committee and a general summary was published in the December, 1952, JOURNAL, the designation 7H.1-1948 being changed to D100-52. The Joint Committee has now recommended further extensive revisions and additions under the designation D100-54.

The NEWWA approved the "Tentative Recommended Practice for Painting and Repainting Elevated Steel Water Storage Tanks, Standpipes, and Reservoirs" on March 20, 1952, which was published in the December, 1952, NEWWA JOURNAL as D102-52T. On January 19, 1953, the AWWA rescinded the use of cold-applied coal tar paint CA-50, as it was found that unless thoroughly and slowly dried, it was likely to impart an unpleasant taste to water. On June 2, 1953, the AWWA approved certain other revisions, the more important restricting the use of cold-applied coal tar paint to parts of tanks above high water level and permitting the use of cold-applied tasteless and odorless tar-base paint to parts of the tank below high water level. Now the Joint Committee representing the AWWA, AWS and NEWWA has suggested further revisions and additions, partly with regard to wax coating, which the AWWA expects to approve and publish in their *Journal*.

The Committee recommends that there be published in the December, 1955, NEWWA JOURNAL a notice similar to that appearing

in the December, 1952, JOURNAL, giving a general summary of the changes in both specifications and stating that copies of the revised documents will be available from AWWA headquarters.

Respectfully submitted,

(*Signed*) GEORGE A. SAMPSON, *Chairman*

PROGRESS REPORT OF COMMITTEE ON DEEP-WELL VERTICAL TURBINE PUMPS

September, 1955

To the New England Water Works Association:

The Committee on Deep-Well Vertical Turbine Pumps (NEWWA 39) presents the following report:

The American Standard Specifications for Deep-Well Vertical Turbine Pumps were approved by the American Standards Association May 11, 1955. The specifications were published in the July, 1955, issue of the Journal of the American Water Works Association under the designations ASA B58.1-1955 and (AWWA A101-55).

The specifications are recommended as a guide for the selection of new deep-well vertical turbine pumps, and the suggested standards are to be considered as a minimum requirement for a first-quality pump.

The Committee has been informed that general specifications for submersible-type pumps and for field testing of well pumps are under consideration. No information regarding these specifications, however, has been received by the Committee. Pending action on these matters, we recommend the Committee be continued.

Respectfully submitted,

(*Signed*) EDWIN B. COBB, *Chairman*

REPORT OF THE COMMITTEE ON CONSERVATION, DEVELOPMENT AND UTILIZATION OF WATER RESOURCES

The Committee on Conservation, Development and Utilization of Water Resources was established in 1951 and since that time has kept the Executive Committee advised of pertinent developments, in order that the Association might take appropriate action.

The urgent need for the establishment of a sound national policy for the development and conservation of our water resources, in which this Committee concurs, has been voiced on many occasions by the present Administration. The President has emphasized, however, that the policy must be one of cooperative endeavor by all agencies concerned and has called for the people to return to the virtue of self-reliance with the Federal Government as a "partner" in their efforts.

A Cabinet Committee on Water Resources Policy was established by President Eisenhower in June, 1954, to develop, in cooperation with Federal, State and private agencies, a policy for the conservation and best utilization of the water resources of the Nation. The Cabinet Committee, consisting of the Secretaries of Agriculture, Commerce, Defense, Interior, and Health, Education and Welfare and the Director of the Bureau of the Budget, was directed to submit its report to the President in December, 1954. Completion of the report was delayed and it has not been received by the President to date.

In this connection Senator Martin of Pennsylvania has introduced a bill, S. 1857, to establish national policy respecting the development and use of water resources. This bill was referred to the Senate Public Works Committee, but action has been deferred pending receipt of the report of the Cabinet Committee on Water Resources Policy.

S. 1857, which is believed to incorporate some of the Cabinet Committee's thinking on the subject, would emphasize, among other things, (1) that major river basins be considered, in general, the most logical units for comprehensive planning and execution of water-

resources development programs; (2) that the interests, rights, and obligations of States and local agencies in planning, financing, and execution of such programs be recognized, and their participation facilitated, through interstate compacts where appropriate, and (3) that loans and grants be provided, to assist States and local public and interstate agencies to construct and to acquire water-resource development programs and projects.

In press summaries of the accomplishments of the 1st Session of the 84th Congress, which ended in August, frequent reference is made to the water-resources program of the President as a major administrative measure to be considered when the 2nd Session of Congress convenes in January.

Of particular interest in connection with our water resources was the introduction into the 1st Session of the 84th Congress of a bill, S. 890, to extend and strengthen the Federal Water Pollution Control Act, which expires June 30, 1956. Public hearings were held and the bill was passed by the Senate with certain amendments, aimed at protecting the rights and responsibilities of State and interstate agencies in water-pollution control. Following a hearing at which further objections were recorded by certain States, action by the House was deferred until the 2nd Session of the 84th Congress, when additional hearings will be scheduled.

The New England-New York Inter-Agency Committee, established by President Truman in 1950 to study the natural resources of the New England-New York area, submitted its report to the President in June and the Committee went out of existence. Many of the States' representatives on the Committee felt that the experience of the last four years demonstrated that there would be over-all advantages and benefits to the area in having an inter-agency organization, with the States as co-partners, to carry on the work of the Federal agencies in this area. Furthermore, the President's Interagency Committee on Water Resources has been contemplating the establishment of an inter-agency organization for the area, which would be federally dominated. A North-Eastern Resources Council has been proposed by the State members of NENYIAC, which would provide for equal representation of State and Federal agencies; it would have no spe-

cific mandatory powers, but would resolve questions of a Federal-State nature and prepare specific programs. The proposed North-Eastern Resources Council charter is now before the Governors of the New England States and New York State for their consideration, and the President's Interagency Committee is reported to be drafting a similar charter for Presidential approbation.

On the State level, the problems concerning water resources received special attention during the past year. In Connecticut, Massachusetts and Rhode Island, special commissions or boards were established to study the water resources of the State and the present laws pertaining thereto.

Your Committee will continue its established policy of closely following water-resources matters and advising the Association of important developments.

Respectfully submitted,

(*Signed*) THOMAS R. CAMP, *Chairman*
JOSEPH C. KNOX
BYRON O. MCCOY

REPORT OF TEMPORARY SCHOLARSHIP COMMITTEE

March 30, 1955

To the New England Water Works Association:

The December 16, 1954, meeting "authorized President Roger G. Oakman to appoint a committee, not exceeding five, to study methods for putting an association-sponsored scholarship into operation, said committee to submit a report to the association prior to the next annual meeting, for action at that time, upon such recommendations as said report may contain". The Committee was duly appointed and reports as follows:

Your committee recommends that an association-sponsored scholarship, to be known as the New England Water Works Association Scholarship, be established in the following manner:

1. A permanent Scholarship Committee of five members be appointed before November 1 by the President and Executive Committee, to solicit donations to and to administer the scholarship fund for the advancement of water-works practice in New England through the members of the New England Water Works Association, the Scholarship Committee to be appointed for five-, four-, three-, two- and one-year terms initially and one member for five years thereafter.

2. Members, associate members, corporate members or individuals, companies or associations on behalf of present or past members be approached by the Scholarship Committee for contributions to a scholarship fund of Twenty-five Thousand Dollars or more. Income may be expended for scholarships when the fund amounts to Ten Thousand Dollars. Contributions from the New England Water Works Association may be added to the fund at any time.

3. Scholarships be awarded by the Scholarship Committee on the basis of merit, character and need to members and junior members of the New England Water Works Association, with preference given to applicants whose programs are considered by the Scholar-

ship Committee as beneficial to water-works practice in New England.

4. A list of names of all donors who have contributed $25 or more be printed annually in the JOURNAL with the annual reports.

5. Association to provide expenses of Scholarship Committee for promoting and administering the fund.

(*Signed*) WILLIAM B. DUFFY, *Chairman*
THOMAS R. CAMP
KENNETH F. KNOWLTON
THOMAS S. LAWRENCE
ROGER W. ESTY

REPORT OF COMMITTEE ON RAINFALL AND YIELD OF DRAINAGE AREAS

RAINFALL IN NEW ENGLAND*

PART II. RAINFALL IN MAINE

AUGUSTA, ME. (Airport)—Elevation 350 feet
Record: January, 1945, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1945	3.58	3.07	1.88	4.72	5.28	3.97	5.53	1.63	3.19	3.41	3.29	3.53	43.08
1946	2.55	1.97	0.91	2.28	3.02	1.50	2.49	4.62	4.34	1.58	2.84	3.41	31.31
1947	3.20	2.53	2.71	1.30	5.11	4.51	4.64	0.37	2.74	0.07	4.66	2.29	34.13
1948	3.97	2.23	2.87	3.78	9.20	3.96	1.61	0.91	0.61	4.34	6.74	4.16	44.38
1949	3.48	1.67	2.15	2.54	3.62	2.51	1.10	1.15	4.78	3.03	4.68	1.49	32.00
1950	3.26	2.07	3.53	3.26	0.71	2.40	1.05	5.17	1.33	2.44	7.75	4.81	37.78
Av. 6 yrs.	3.34	2.26	2.31	2.95	4.49	3.14	2.74	2.31	2.83	2.48	4.99	3.28	37.12

AZISCOHOS DAM, ME. (Union Water Power Co.)
Record: January, 1911, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	2.29	1.72	3.50	2.31	1.94	6.31	1.46	1.13	4.90	2.54	3.44	3.06	34.60
1943	0.99	2.37	2.23	3.15	3.35	8.84	2.65	4.95	1.99	4.17	6.27	1.55	42.51
1944	1.96	2.54	2.59	2.04	2.32	3.99	3.78	3.21	4.17	3.96	3.09	2.82	36.47
1945	4.22	3.14	2.31	4.02	5.81	2.53	5.14	2.96	6.31	4.24	3.26	1.65	45.59
1946	3.27	2.48	1.32	3.17	3.14	1.88	2.21	4.32	4.62	3.34	3.41	4.47	37.63
1947	3.34	2.87	2.29	2.04	5.47	4.07	4.48	1.42	3.18	1.30	4.12	1.67	36.25
1948	2.24	1.68	2.50	2.93	5.87	1.70	2.67	1.77	0.74	2.24	5.56	2.48	32.38
1949	2.36	2.16	2.57	2.77	3.55	4.13	3.27	2.42	3.11	2.27	3.10	2.90	34.61
1950	4.48	1.86	3.23	3.07	1.17	5.68	1.98	5.21	0.99	2.01	6.01	2.75	38.44
Av. 40 yrs.	2.52	1.98	2.63	2.78	3.17	3.79	3.66	3.53	3.59	3.18	3.39	2.56	36.78

BANGOR, ME.—Elevation 100 feet
Record: June, 1925, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	2.98	2.18	5.62	2.22	2.31	6.36	2.00	0.72	3.21	2.24	4.10	3.29	37.23
1943	0.80	1.74	2.76	2.10	4.32	4.18	2.67	4.90	2.97	8.17	7.29	1.07	42.97
1944	0.58	3.39	3.01	2.45	0.84	4.39	1.67	1.28	5.00	4.27	4.72	2.60	34.20
1945	3.16	2.12	1.78	5.66	7.02	3.86	2.35	0.93	3.17	4.28	3.73	3.46	41.52
1946	2.64	1.89	1.12	3.02	3.37	1.27	3.22	3.86	3.60	2.13	3.90	3.30	33.32
1947	2.88	2.36	1.65	3.40	6.41	4.30	4.76	1.47	3.46	0.20	4.00	1.01	35.90
1948	2.77	0.84	2.36	2.24	6.26	2.64	2.21	0.81	0.74	2.65	4.96	2.20	30.68
1949	3.84	2.60	1.67	3.43	2.96	2.65	1.55	0.61	4.18	2.15	5.08	1.67	32.39
1950	3.70	2.28	2.14	3.75	0.35	1.54	1.58	5.37	1.20	1.90	8.39	6.03	38.33
Av. 25 yrs.	2.96	2.21	2.78	3.25	3.37	3.10	2.65	2.75	3.51	3.76	3.80	2.92	37.06

* Continued from this JOURNAL 68: 1, 39, March, 1954.

BAR HARBOR, ME.—Elevation 20 feet
Record: 1871-1879; 1886-1920; November, 1926, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	5.06	3.63	7.04	3.67	2.77	7.65	5.00	2.19	3.87	3.72	4.45	3.77	52.82
1943	1.42	2.50	3.72	3.12	5.70	2.48	5.28	9.25	2.61	8.54	7.18	1.01	52.81
1944	0.53	3.69	5.37	3.14	0.43	2.72	1.97	0.74	5.83	3.79	7.07	4.33	39.61
1945	3.96	3.97	2.42	4.70	9.52	4.79	2.91	1.66	2.15	5.57	6.03	4.54	52.22
1946	2.91	4.84	1.66	3.00	3.37	1.16	1.62	5.34	0.90	2.57	3.31	6.02	36.70
1947	3.73	3.90	3.89	1.62	7.58	4.03	4.42	0.56	2.38	0.08	5.56	2.73	40.48
1948	4.22	1.72	3.33	2.83	7.81	3.20	3.61	0.95	1.07	4.25	6.77	4.26	44.02
1949	4.62	4.95	2.20	2.94	3.16	2.89	1.01	0.53	4.46	3.18	4.95	2.81	37.70
1950	5.62	2.86	2.55	3.27	0.95	3.52	2.89	3.42	2.28	1.55	9.37	6.69	44.97
Av. 67 yrs.	4.52	3.81	4.61	3.58	3.52	3.31	3.32	3.20	3.74	4.28	4.77	4.33	46.99

BELFAST, ME.
Record: June, 1945, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1945	—	—	—	—	—	2.30	1.85	3.43	3.63	5.61	5.26	—	—
1946	4.98	2.04	1.22	3.58	3.25	1.37	2.70	3.90	1.46	3.97	4.07	5.11	37.65
1947	4.61	3.88	3.24	1.64	5.10	5.12	4.43	0.69	2.77	0.17	5.41	3.57	40.63
1948	3.29	1.49	2.49	3.18	8.12	3.41	2.45	0.64	0.64	3.88	6.81	3.02	39.42
1949	4.95	3.37	2.00	2.70	3.21	3.68	2.55	1.17	3.89	2.52	6.00	1.92	37.96
1950	5.45	2.83	2.70	4.66	0.54	2.36	1.59	2.89	1.50	2.72	11.40	7.39	46.03
Av. 5 yrs.	4.66	2.72	2.33	3.15	4.04	3.19	2.74	1.86	2.05	2.65	6.74	4.20	40.33

BIDDEFORD, ME.—Elevation 75 feet
Record: January, 1881, to February, 1949

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1939	1.83	1.63	4.93	5.12	0.91	1.84	2.16	3.60	2.14	1.87	2.02	3.15	31.20
1940	3.97	2.68	4.74	7.05	5.12	2.69	3.96	1.06	4.08	0.10	5.72	3.46	44.63
1941	2.35	2.91	1.61	0.49	1.57	1.06	0.78	2.19	0.87	2.51	3.47	2.92	22.73
1942	2.51	3.54	5.85	1.06	1.80	3.93	4.60	1.37	1.44	2.54	5.38	5.51	39.53
1943	1.97	2.09	2.32	3.37	6.58	2.34	4.87	2.85	1.81	6.10	6.16	0.77	41.23
1944	3.12	3.43	5.10	3.81	1.46	5.23	2.33	0.48	6.68	2.75	6.41	3.95	44.75
1945	3.98	3.30	2.27	3.12	7.22	8.63	3.46	1.59	3.39	4.43	4.15	3.99	49.53
1946	4.25	1.43	1.06	2.74	4.43	1.75	1.84	9.13	3.86	1.18	1.92	4.35	37.94
1947	3.50	1.66	2.87	2.24	4.64	4.03	2.82	0.17	1.97	0.31	4.80	1.72	30.73
1948	2.05	1.50	1.70	2.48	5.21	3.29	1.32	2.17	1.11	3.29	5.94	3.69	33.75
1949	4.49	3.39	—	—	—	—	—	—	—	—	—	—	—
Av. 68 yrs.	3.25	3.10	3.67	3.68	3.88	3.65	3.33	3.37	3.59	3.62	3.80	3.58	42.52

BINGHAM, ME. (Central Maine Power Co.)
Record: April, 1931, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1931	—	—	—	2.80	5.03	5.43	4.82	4.96	4.44	3.79	1.59	3.73	—
1932	2.67	—	4.31	2.56	2.81	2.04	4.31	—	8.63	2.34	5.59	1.49	—
1933	1.88	2.08	3.14	4.95	3.15	1.51	6.04	4.29	2.71	5.31	1.88	3.02	39.96
1934	3.11	1.90	1.82	5.54	1.33	3.94	1.96	2.45	6.08	1.97	3.13	3.11	36.34
1935	5.65	1.42	1.12	3.96	2.02	4.93	4.81	1.32	3.95	1.01	4.46	1.98	36.63
1936	5.75	2.43	10.07	4.68	2.99	1.79	2.69	3.33	2.14	5.77	2.00	5.95	49.59
1937	3.81	3.14	2.27	2.56	6.41	4.04	2.55	1.49	4.06	9.14	3.37	2.48	45.32
1938	5.48	2.48	3.08	1.64	4.41	2.70	7.07	2.24	5.90	2.55	1.98	4.50	44.03
1939	1.78	2.99	2.26	3.96	1.85	1.84	4.39	3.37	3.88	4.48	0.50	4.61	35.91
1940	1.16	1.35	3.37	5.99	3.95	3.58	1.76	2.55	4.55	0.57	5.88	2.63	37.34

BINGHAM, ME. (Central Maine Power Co.) (Continued)
Record: April, 1931, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1941	1.50	1.73	1.88	0.86	3.09	1.84	2.88	4.48	2.14	3.01	2.37	2.64	28.42
1942	2.75	2.74	5.09	1.73	2.71	5.90	1.40	3.60	3.97	2.85	2.96	4.29	39.99
1943	1.34	1.98	2.46	3.05	3.86	4.85	4.19	2.97	1.28	5.94	8.37	0.65	40.94
1944	1.04	2.47	3.31	2.09	1.34	2.67	3.26	1.81	5.29	4.34	3.54	2.24	33.45
1945	4.04	2.27	1.38	4.50	4.43	3.13	5.66	1.83	5.13	5.59	2.26	3.52	43.74
1946	3.48	2.11	1.02	3.42	3.82	1.18	3.49	3.62	5.94	2.31	2.96	2.98	36.33
1947	2.48	2.78	2.32	1.42	5.10	4.53	4.46	0.91	3.14	0.32	3.91	1.46	32.83
1948	1.65	1.73	2.16	3.83	8.30	0.86	2.98	2.48	0.27	3.98	7.30	3.59	39.13
1949	3.00	2.00	1.73	3.23	3.67	2.31	4.41	3.56	3.77	2.18	3.91	1.74	35.51
1950	4.80	1.79	4.79	3.17	1.41	1.43	4.29	4.36	1.00	3.10	9.13	5.65	44.92
Av. 18 yrs.	3.04	2.19	2.96	3.36	3.55	2.95	3.79	2.81	3.62	3.58	3.88	3.17	38.90

BRASSUA DAM, ME.
Record: March, 1928, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	1.57	2.85	3.83	3.15	2.22	5.32	2.39	5.05	4.36	2.26	2.80	4.15	39.95
1943	1.23	2.12	3.61	3.31	3.17	6.14	2.70	4.85	1.31	6.54	5.43	1.26	41.67
1944	1.61	2.53	3.19	2.44	1.61	4.64	3.51	2.19	5.77	3.93	1.59	3.95	36.96
1945	3.70	2.08	1.92	5.78	6.10	3.36	6.35	1.79	5.00	4.07	3.32	2.37	45.84
1946	3.80	2.35	1.34	3.75	2.92	2.40	2.46	2.90	0.99	6.44	3.01	3.44	35.80
1947	1.74	4.12	2.41	2.48	5.15	3.92	3.97	1.53	2.47	0.93	3.69	1.09	33.50
1948	1.72	0.92	2.80	2.23	7.69	1.05	3.16	2.46	0.88	3.98	5.40	2.80	35.09
1949	2.68	2.46	1.35	2.03	2.97	2.22	2.70	3.35	2.38	1.34	4.25	1.51	29.24
1950	2.84	2.24	3.57	1.91	0.96	6.26	2.78	4.27	1.16	3.07	6.03	4.64	39.73
Av. 21 yrs.	2.77	2.14	3.07	3.10	3.17	3.73	3.55	2.97	3.35	3.30	3.38	2.79	37.32

BRIDGTON, ME. (North Bridgton)—Elevation 450 feet
Record: November, 1893, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	3.07	3.01	6.16	1.94	2.04	10.88	3.77	1.63	3.85	2.35	4.75	5.29	48.74
1943	2.40	2.30	2.77	3.64	4.63	4.11	4.87	4.15	1.35	6.65	7.28	1.05	45.70
1944	2.46	4.26	4.86	3.46	1.00	7.33	4.42	1.53	6.98	2.96	6.33	2.92	48.51
1945	4.62	4.07	1.96	4.73	8.69	6.27	4.09	3.00	3.29	5.07	6.94	4.87	57.60
1946	3.56	2.50	1.18	2.96	4.22	1.99	3.07	11.86	0.91	2.28	2.93	4.13	47.59
1947	4.14	3.14	3.54	1.71	5.88	4.87	4.08	0.96	1.74	0.32	5.07	2.35	37.80
1948	3.25	1.43	2.43	2.46	8.35	3.84	2.82	2.10	0.57	3.67	7.71	5.83	44.46
1949	4.80	2.67	2.11	3.21	3.33	1.33	1.26	2.33	4.36	2.61	4.20	1.94	34.15
1950	4.88	3.30	4.87	3.49	1.31	2.66	1.19	4.30	1.69	2.80	6.91	5.31	42.71
Av. 57 yrs.	3.58	3.21	3.91	3.55	3.58	3.77	3.96	3.52	3.80	3.26	3.96	3.56	43.66

CARIBOU, ME.—Elevation 624 feet
Record: February, 1939, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1939	—	2.22	1.81	2.94	2.15	2.58	3.42	—	—	4.14	0.45	—	—
1940	—	—	4.35	3.94	2.44	7.11	4.51	2.20	3.89	2.02	4.96	3.48	—
1941	2.03	1.19	1.91	1.95	3.13	5.11	5.70	5.30	3.97	4.81	2.72	2.38	40.20
1942	1.44	2.05	3.23	1.05	2.27	4.85	1.97	3.44	3.04	3.02	1.87	2.42	30.65
1943	0.82	2.11	1.53	2.17	2.31	4.22	4.41	5.15	1.97	4.22	2.77	0.79	32.47
1944	0.12	1.47	—	0.92	1.01	3.94	3.22	1.52	3.71	6.20	2.48	2.10	—
1945	3.59	1.39	1.94	3.26	5.23	3.95	5.35	2.48	5.90	2.99	3.01	1.69	40.78
1946	1.53	2.43	2.29	2.43	3.36	2.99	3.69	4.13	1.54	3.50	4.38	2.72	34.99
1947	2.48	3.12	2.43	3.65	6.27	3.72	5.69	2.36	3.09	0.90	2.60	0.81	37.12
1948	1.19	1.14	2.34	2.30	5.91	3.12	2.73	3.45	3.27	4.63	4.14	2.92	37.14
1949	2.50	2.21	2.48	2.11	3.91	3.82	5.35	2.49	4.40	2.35	5.87	2.14	39.63
1950	2.94	2.31	2.29	2.60	0.67	4.55	2.47	4.23	1.26	1.99	6.53	4.98	36.82
Av. 9 yrs.	2.06	1.99	2.27	2.39	3.67	4.04	4.15	3.67	3.16	3.16	3.76	2.32	36.64

EASTPORT, ME.—Elevation 53 feet
Record: 1833 to 1834; 1871 to 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	2.68	1.29	4.13	1.57	1.45	3.06	2.62	1.88	3.48	2.79	2.68	2.66	30.29
1943	1.54	3.50	4.37	2.92	2.65	6.01	4.21	6.61	3.74	5.11	7.57	1.41	49.64
1944	0.91	4.42	4.66	3.21	0.79	3.10	1.75	0.66	7.65	5.13	4.53	4.30	41.11
1945	4.47	3.96	4.40	3.38	8.18	4.73	2.14	1.39	2.07	6.37	6.90	3.72	51.71
1946	3.24	5.48	2.47	6.35	3.62	0.76	2.18	2.67	1.90	2.55	2.79	5.93	39.94
1947	3.74	4.70	3.45	2.05	5.44	5.73	4.68	0.64	2.07	0.19	4.68	2.93	40.30
1948	5.10	1.90	2.80	2.86	5.66	3.06	5.37	1.48	0.92	3.26	6.35	3.68	42.44
1949	4.56	4.35	3.15	2.57	3.04	1.58	1.00	1.85	6.10	1.82	7.01	2.75	39.78
1950	4.93	3.58	2.61	3.83	0.75	4.98	3.05	5.33	1.10	2.33	8.57	8.40	49.46
Av. 82 yrs.	3.56	3.09	3.59	2.82	3.03	3.10	3.11	3.09	3.07	3.71	3.65	3.47	39.29

ELLSWORTH ME.—Elevation 30 feet

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	3.31	2.26	6.98	2.34	2.68	7.93	3.83	2.09	3.33	3.51	4.32	2.57	45.15
1943	1.25	2.75	3.31	3.64	5.25	3.14	5.38	5.33	2.87	8.61	8.38	1.29	51.20
1944	0.41	3.69	3.82	2.43	1.15	3.14	1.81	0.79	7.00	4.64	7.16	3.47	39.51
1945	3.92	2.93	2.95	5.44	7.71	4.19	3.03	1.60	3.31	4.61	5.56	3.10	48.35
1946	3.67	5.73	1.86	3.16	3.73	1.41	2.35	3.94	2.30	1.71	3.79	4.86	38.51
1947	3.25	4.07	3.30	2.35	7.62	4.31	4.10	0.91	1.82	0.17	5.20	1.51	38.61
1948	3.24	1.52	1.96	2.22	5.49	2.61	1.29	0.32	0.98	3.21	5.49	3.85	32.18
1949	3.50	2.28	2.30	2.22	2.67	1.92	1.21	0.78	4.19	2.05	3.98	2.84	29.94
1950	5.05	2.79	2.31	3.11	0.52	2.68	4.00	3.13	1.47	1.94	8.15	5.56	40.71
Av. 42 yrs.	3.58	2.95	3.60	3.68	3.06	3.23	3.13	2.90	3.85	3.99	3.99	3.50	41.46

EUSTIS, ME.
Record: January, 1914, to November, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	1.16	2.37	4.05	2.58	2.66	7.69	2.28	2.21	4.14	2.09	2.74	4.14	38.11
1943	1.17	2.25	2.70	2.10	3.00	6.67	4.72	3.27	1.74	4.29	6.55	1.30	39.76
1944	2.62	2.01	2.31	2.14	1.32	3.26	3.60	2.93	4.68	3.84	3.33	3.22	35.26
1945	4.20	2.28	2.35	4.19	6.67	3.45	5.85	1.18	4.91	3.75	4.53	2.17	45.53
1946	3.03	2.07	1.05	3.49	3.20	2.62	3.34	3.95	3.63	3.53	3.10	4.17	37.18
1947	2.14	3.36	3.76	1.51	5.23	4.19	3.89	0.72	2.39	0.80	3.54	1.52	33.05
1948	2.08	1.56	2.32	2.05	7.10	3.00	2.61	2.47	—	—	—	—	—
1949	—	1.76	1.33	1.65	2.37	1.83	—	1.40	1.85	1.70	2.75	1.45	—
1950	3.45	1.40	2.90	1.70	0.55	5.05	1.10	3.80	0.60	1.95	5.85	—	—
Av. 34 yrs.	2.57	2.07	2.60	2.87	3.07	3.83	3.54	3.09	3.29	3.31	3.09	2.69	36.02

FARMINGTON, ME.—Elevation, 450 feet
Record: January, 1891, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	3.29	3.01	6.34	2.84	2.22	6.21	4.00	2.25	3.88	3.62	4.08	4.62	46.36
1943	1.33	2.22	2.90	3.48	5.26	6.28	4.95	4.98	1.99	7.18	9.03	0.70	50.25
1944	1.75	3.66	3.58	2.92	0.91	4.02	5.03	1.04	5.09	3.15	5.16	2.61	38.92
1945	4.92	3.55	1.96	4.97	7.26	3.20	3.41	2.94	3.46	7.16	5.90	4.41	53.14
1946	3.73	2.27	1.08	3.03	3.10	1.91	3.84	4.47	5.36	3.15	2.93	4.49	39.36
1947	3.19	3.37	3.66	1.62	5.66	4.55	5.32	1.26	1.75	0.14	5.33	1.88	37.73
1948	2.28	1.05	2.78	2.45	7.69	2.80	2.45	1.52	0.52	3.01	7.98	4.17	38.70
1949	3.24	2.77	—	3.27	3.16	3.47	2.57	2.03	3.19	2.06	4.24	1.82	—
1950	5.62	2.30	5.83	3.62	1.38	4.93	2.07	4.09	1.53	2.69	6.71	5.43	46.20
Av. 59 yrs.	3.37	2.82	3.83	3.42	3.64	3.75	3.66	3.60	3.73	3.54	3.89	3.50	42.75

FORT FAIRFIELD, ME.
Record: January, 1935, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1935	4.70	1.82	1.20	2.13	2.21	6.28	4.23	2.32	4.46	1.17	3.70	1.40	35.62
1936	5.52	2.72	3.81	4.10	6.51	4.16	3.71	3.46	3.62	5.68	2.90	4.38	50.57
1937	2.02	2.14	2.72	1.06	2.87	3.54	2.53	3.50	3.61	5.27	3.08	2.51	34.85
1938	1.81	1.81	1.56	3.29	3.36	5.64	6.76	5.89	3.44	2.13	2.61	4.80	43.10
1939	1.65	2.68	2.93	2.95	2.06	2.37	5.61	1.73	3.97	6.50	0.39	3.51	36.35
1940	1.03	1.52	3.32	3.53	2.42	7.62	4.19	1.23	4.54	2.55	6.03	3.00	40.98
1941	3.09	1.24	3.07	1.70	3.78	5.67	4.31	3.19	4.15	3.64	2.51	2.97	39.32
1942	1.74	3.52	4.28	1.25	1.87	4.62	1.71	3.27	3.14	—	2.42	1.88	—
1943	0.93	3.12	2.72	4.08	2.30	4.73	3.75	4.82	2.55	3.88	3.37	0.82	37.07
1944	0.38	2.12	2.77	1.38	1.83	2.86	2.76	1.94	4.53	7.65	2.39	2.50	33.11
1945	4.83	1.97	2.29	3.65	5.11	4.00	5.09	2.41	5.29	3.22	4.34	1.81	44.01
1946	3.52	3.12	1.92	3.30	3.25	2.87	3.97	4.15	0.79	3.45	3.90	3.48	37.72
1947	2.49	3.20	2.42	3.73	5.62	4.84	4.65	2.16	2.50	1.17	2.95	1.29	37.02
1948	1.16	0.96	3.01	2.45	4.82	1.81	2.79	2.53	2.99	—	—	2.68	—
1949	2.01	2.61	2.91	2.14	4.06	3.44	*	7.59	3.38	1.37	5.28	2.88	37.67
1950	2.33	2.64	—	1.90	0.96	5.77	3.23	2.92	1.39	1.87	7.86	6.28	—
Av. 12 yrs.	2.66	2.29	2.56	2.91	3.44	4.55	4.30	3.07	3.62	3.86	3.18	2.70	39.14

* Included in following month's total.

FORT KENT, ME.
Record: January, 1937, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1937	2.41	2.56	2.10	0.74	3.05	4.03	2.68	5.20	3.21	5.13	3.46	1.26	35.83
1938	2.87	1.21	1.18	2.79	3.57	3.16	4.93	5.24	3.84	2.03	1.22	3.51	35.55
1939	1.02	3.71	1.61	2.05	2.46	2.88	10.51	9.97	3.81	5.12	0.48	3.64	47.26
1940	1.83	1.12	2.23	3.86	3.16	6.97	3.37	1.69	2.94	1.76	5.06	3.09	37.08
1941	1.59	1.01	2.76	1.90	2.03	4.05	4.58	3.44	4.71	5.36	2.70	2.48	36.61
1942	1.47	2.67	4.17	1.02	1.42	5.35	3.15	2.11	2.67	1.78	2.11	2.93	30.85
1943	0.81	1.91	2.13	2.06	1.89	4.09	2.93	4.96	0.41	5.17	3.18	—	—
1944	0.38	1.16	2.08	1.45	0.81	3.93	4.54	1.53	4.70	4.47	—	1.87	—
1945	4.63	2.01	2.37	4.14	3.72	3.31	5.05	1.49	4.63	2.15	2.47	1.85	37.82
1946	2.48	2.60	1.85	2.57	3.61	1.14	3.20	4.20	1.38	3.25	3.34	2.42	32.04
1947	2.32	4.09	3.67	3.39	5.53	3.65	7.38	2.63	3.20	0.63	4.05	1.32	41.86
1948	1.65	—	2.71	2.11	3.87	3.91	3.09	3.71	2.93	5.00	3.72	1.97	—
1949	2.28	2.00	2.59	2.01	—	—	—	—	3.75	1.80	3.70	1.71	—
1950	2.66	1.95	2.90	—	1.17	6.86	2.77	2.68	1.64	2.30	7.00	4.87	—
Av. 9 yrs.	2.29	2.33	2.44	2.49	3.17	3.84	4.98	4.00	3.38	3.02	2.77	2.50	37.21

GARDINER, ME.—Elevation 163 feet
Record: January, 1837, to November, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	2.91	3.07	5.86	3.29	1.82	6.72	4.95	1.18	4.00	2.98	4.26	4.82	45.86
1943	1.73	3.12	2.36	2.85	6.30	2.11	4.50	4.36	1.84	7.26	6.65	1.20	44.28
1944	2.47	4.47	4.19	3.88	0.46	5.79	3.78	1.06	4.15	3.88	7.12	3.06	44.31
1945	4.83	3.35	2.12	5.43	7.32	5.66	4.87	1.67	4.06	4.31	4.72	4.40	52.74
1946	3.34	2.78	1.18	3.62	3.26	1.34	2.56	4.04	2.58	2.70	2.53	4.14	34.07
1947	3.84	3.49	2.89	1.59	5.13	4.09	4.37	0.32	1.98	0.12	4.85	1.93	34.60
1948	2.78	1.57	2.43	2.99	8.51	3.39	2.57	1.39	0.90	3.46	7.88	3.90	41.77
1949	4.42	2.79	2.24	3.14	3.47	2.30	1.31	0.96	4.53	2.98	4.89	1.40	34.43
1950	3.76	2.89	4.27	3.59	1.05	4.08	1.02	4.86	1.50	2.45	8.22	—	—
Av. 112 yrs.	3.66	3.39	3.86	3.47	3.64	3.27	3.44	3.38	3.48	4.02	4.01	3.65	43.27

GREENVILLE, ME.—Elevation 1,140 feet
Record: January, 1885, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	2.47	2.71	4.41	2.96	2.69	5.73	3.12	4.14	4.39	2.25	3.00	4.88	42.75
1943	1.19	2.67	3.58	3.58	3.60	5.25	1.80	2.94	2.38	7.74	6.68	1.05	42.46
1944	1.02	2.87	3.14	2.30	1.41	3.22	2.36	2.83	5.11	3.88	3.90	2.80	34.84
1945	4.48	2.32	1.92	5.46	6.09	2.76	5.53	1.64	6.66	5.28	4.07	3.18	49.39
1946	3.68	2.81	1.32	4.20	3.68	2.41	3.45	5.10	7.45	2.53	3.11	4.00	43.74
1947	2.21	6.37	4.17	2.30	5.42	4.71	6.37	1.02	2.85	0.66	5.54	1.41	43.03
1948	1.89	1.00	3.04	3.74	7.71	2.32	2.59	2.13	0.88	4.62	6.45	3.74	40.11
1949	2.60	2.13	1.88	3.01	3.60	2.91	3.18	2.79	3.33	2.20	3.43	1.53	32.59
1950	4.27	2.06	4.22	3.50	1.46	6.96	2.62	5.16	1.12	3.48	10.58	4.75	50.18
Av. 49 yrs.	2.94	2.56	3.14	3.34	3.51	3.94	4.43	3.42	3.82	3.68	3.68	3.23	41.69

GULF ISLAND DAM, ME.
Record: May, 1935, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1935	—	—	—	—	1.42	5.34	2.10	2.41	5.19	0.65	3.73	1.25	—
1936	—	—	—	4.24	—	—	—	2.42	—	—	—	6.29	—
1937	—	3.62	4.24	—	—	3.40	2.90	1.62	1.58	5.99	5.30	2.80	—
1938	5.46	2.16	2.46	1.91	3.78	—	—	—	—	3.21	1.55	4.75	—
1939	1.61	—	3.49	—	—	—	—	—	—	3.26	0.56	—	—
1940	2.33	1.77	4.08	6.79	4.17	1.73	3.92	—	—	—	—	2.69	—
1941	1.99	2.36	2.70	0.47	2.06	0.89	—	—	1.11	—	—	—	—
1942	2.29	3.34	6.36	3.15	1.27	6.96	—	—	2.80	2.05	—	—	—
1943	—	—	—	—	—	—	—	3.38	1.73	—	7.02	0.85	—
1944	2.68	4.13	3.82	3.50	0.55	4.75	3.46	1.04	6.05	2.82	6.40	2.82	42.02
1945	4.53	3.01	1.42	3.92	6.82	4.67	3.59	2.47	2.85	6.22	5.64	5.31	50.45
1946	3.17	3.14	1.20	2.28	4.02	1.89	4.90	7.40	5.41	1.79	3.23	4.03	42.46
1947	4.23	3.51	3.18	2.26	5.35	4.65	4.32	0.63	3.59	0.14	4.66	1.94	38.46
1948	3.07	1.77	2.91	3.72	7.49	3.77	1.55	1.87	1.39	3.14	7.03	5.59	43.30
1949	4.11	2.58	2.50	5.10	3.24	2.43	1.48	1.54	5.01	2.69	4.57	2.07	37.32
1950	4.83	3.22	6.36	3.81	1.11	3.21	1.17	3.72	1.41	3.44	7.06	5.77	45.11
Av. 7 yrs.	3.80	3.05	3.05	3.51	4.08	3.62	2.92	2.68	3.07	2.89	5.51	3.93	42.71

HIRAM, ME.
Record: April, 1925, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	2.21	3.39	6.77	1.87	1.59	8.17	3.90	1.43	3.00	2.25	5.75	5.37	45.70
1943	1.90	2.02	2.38	3.85	4.76	2.50	6.98	7.00	1.38	5.34	5.76	0.60	44.47
1944	1.83	3.42	5.57	3.45	0.93	5.29	4.14	1.14	8.54	4.04	5.26	3.38	46.99
1945	4.60	3.79	1.97	3.77	7.88	6.22	3.49	1.58	2.91	4.58	6.06	4.91	51.76
1946	3.38	2.95	0.98	2.42	2.50	0.89	4.80	11.30	6.83	1.42	2.41	4.32	44.20
1947	3.58	1.98	3.34	1.54	5.67	4.58	6.02	0.33	2.23	0.13	5.02	2.44	36.86
1948	3.14	1.88	2.37	3.00	6.42	3.06	1.37	2.23	0.49	2.87	6.45	4.83	38.11
1949	5.13	2.46	1.89	3.79	3.47	1.04	2.91	2.50	2.81	2.28	3.87	1.61	33.76
1950	5.38	3.14	5.19	3.05	0.91	3.47	0.85	7.37	2.07	2.72	7.42	4.70	46.27
Av. 24 yrs.	3.57	3.05	3.64	3.66	3.28	3.67	3.69	3.52	3.77	2.99	4.43	3.47	42.74

HOULTON, ME.—Elevation 362 feet
Record: January, 1892, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	1.48	2.64	4.95	1.37	2.24	6.22	2.23	3.67	3.72	1.37	2.81	3.08	35.78
1943	1.27	3.14	2.95	2.28	2.84	3.80	3.12	2.79	3.37	5.75	4.05	0.84	36.20
1944	0.15	2.15	2.78	1.82	0.83	4.82	2.72	2.90	5.77	6.05	3.49	2.36	36.54
1945	4.92	2.13	2.03	4.06	4.54	2.41	4.30	1.80	4.41	3.17	3.21	2.48	39.46
1946	2.47	2.84	1.58	3.47	3.80	1.74	2.06	2.69	1.54	2.16	4.04	3.19	31.58
1947	2.40	2.70	2.56	2.17	4.53	4.68	5.06	2.62	2.27	0.37	3.08	1.07	33.51
1948	1.63	1.13	2.57	2.28	4.45	2.15	3.03	1.63	2.09	4.04	4.48	2.60	32.08
1949	3.55	2.52	2.33	1.99	2.34	2.13	2.55	2.86	5.71	2.18	4.53	2.70	35.39
1950	2.80	2.66	2.04	3.52	0.67	4.15	2.45	4.03	0.67	2.27	9.08	6.71	41.05
Av. 52 yrs.	2.70	2.07	2.42	2.45	2.45	3.23	2.96	2.83	3.16	3.49	2.92	2.67	33.35

JACKMAN, ME.
Record: August, 1921, to November, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	1.43	2.65	3.16	1.46	2.06	5.92	1.96	4.59	4.13	2.15	2.01	4.44	35.96
1943	1.04	2.22	3.04	2.31	2.86	6.94	3.00	2.84	1.72	4.68	3.69	1.11	35.45
1944	1.65	2.14	2.49	1.78	0.88	4.05	5.74	1.76	4.41	3.01	3.54	3.32	34.77
1945	4.40	3.02	2.26	6.77	5.92	3.54	5.59	1.51	5.56	3.50	3.26	1.38	46.71
1946	3.26	3.55	1.24	2.84	3.58	2.17	1.31	2.68	3.22	2.39	3.44	4.97	34.65
1947	1.75	3.06	3.11	2.42	5.54	3.63	3.00	1.44	0.87	0.97	3.31	1.11	30.21
1948	1.54	1.39	2.48	2.04	6.04	1.11	3.21	2.34	0.62	1.82	5.10	3.52	31.21
1949	2.67	1.74	1.49	3.13	2.47	2.64	3.52	2.46	2.64	1.18	4.54	1.84	30.32
1950	4.22	2.06	3.68	1.78	0.30	6.38	2.78	5.30	3.08	5.09	5.68	—	—
Av. 28 yrs.	2.48	2.09	2.49	2.85	3.43	3.84	3.52	2.82	3.32	2.99	3.25	2.68	35.76

LEWISTON, ME.
Record: January, 1875, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	2.59	3.37	6.18	2.93	1.42	6.54	2.92	1.09	2.82	2.21	4.23	5.35	41.65
1943	2.03	2.86	2.64	3.12	6.36	3.11	4.04	4.63	1.63	7.55	7.31	1.07	46.35
1944	2.68	3.95	4.26	3.57	0.57	5.25	3.99	1.43	6.29	4.35	7.75	3.58	47.67
1945	4.87	3.61	2.13	4.01	7.45	5.39	3.18	2.45	2.49	5.74	5.99	4.81	52.12
1946	3.35	3.19	1.01	2.79	3.05	1.59	4.59	7.30	4.65	1.64	2.49	4.71	40.36
1947	4.15	3.62	3.10	1.69	4.69	4.07	5.89	0.70	2.75	0.08	4.58	2.24	37.56
1948	3.41	1.58	2.53	3.03	6.53	3.89	1.49	2.04	0.91	3.25	6.77	5.22	40.65
1949	4.25	2.67	2.37	4.51	3.00	1.52	1.13	1.96	4.07	2.49	4.40	1.88	34.25
1950	4.98	3.24	6.46	3.30	0.84	3.14	0.93	2.71	1.44	2.85	6.42	5.30	41.61
Av. 76 yrs.	3.35	3.54	4.17	3.49	3.38	3.43	3.57	3.05	3.57	3.52	3.95	3.88	43.40

LIVERMORE, ME.—Elevation 338 feet
Record: October, 1909, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	2.88	3.30	6.99	2.39	1.90	7.48	2.49	1.14	3.18	2.28	3.76	5.80	43.59
1943	1.30	2.21	2.70	4.06	5.28	2.13	3.71	4.05	1.89	6.71	7.15	0.88	42.07
1944	2.31	3.44	4.05	3.40	0.67	5.12	4.35	2.22	6.07	2.65	6.13	4.05	44.46
1945	4.79	3.68	2.25	4.28	8.10	3.36	3.53	3.18	2.18	7.10	4.98	4.43	51.86
1946	5.07	3.02	1.16	2.92	2.80	2.19	5.27	5.35	6.15	1.89	2.92	6.39	45.13
1947	3.82	4.20	3.20	2.73	4.46	3.76	5.87	0.35	2.48	0.12	5.08	2.26	38.33
1948	3.66	1.70	3.02	3.43	6.01	2.17	2.49	0.94	0.73	2.87	7.57	4.95	39.34
1949	3.74	3.15	2.63	3.42	3.06	4.38	1.45	1.94	3.09	2.80	4.04	2.13	35.83
1950	5.12	2.89	5.80	3.61	0.95	4.41	2.16	6.05	1.23	3.10	7.36	5.71	47.89
Av. 40 yrs.	3.33	2.83	3.62	3.58	3.41	3.35	3.49	3.61	3.78	3.45	4.06	3.55	42.06

LOVELL, ME.
Record: January, 1936, to October, 1948

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1936	5.99	2.25	12.67	4.34	0.95	2.25	2.70	2.16	1.76	4.89	1.61	7.02	48.59
1937	2.94	3.77	3.38	3.28	8.17	3.33	1.72	3.41	2.98	4.22	6.14	1.44	44.78
1938	7.06	1.88	1.77	2.22	2.31	2.51	6.85	2.82	5.03	2.81	2.71	5.44	43.41
1939	3.59	2.52	4.96	5.02	0.93	2.59	2.17	5.35	2.59	2.32	2.27	3.04	37.35
1940	2.04	1.85	4.42	5.39	3.14	3.96	4.11	0.22	5.36	0.00	6.25	3.14	39.88
1941	1.59	2.42	2.22	0.36	3.07	2.03	6.75	3.34	1.59	2.57	3.12	3.52	32.58
1942	3.15	3.30	6.81	1.90	1.71	9.78	4.49	0.96	2.24	3.27	4.51	4.33	46.95
1943	1.99	2.71	2.11	3.44	4.72	3.06	4.88	3.31	1.69	6.07	6.99	0.94	41.91
1944	1.99	2.68	4.60	3.93	1.68	8.74	5.33	0.88	5.28	2.63	4.65	2.94	46.33
1945	6.02	3.20	2.90	4.01	7.50	5.91	3.68	2.64	4.26	5.11	3.87	5.66	54.76
1946	3.18	2.20	0.67	3.89	3.54	2.98	3.64	10.77	4.38	1.63	2.08	7.10	46.06
1947	2.52	1.31	2.57	1.81	5.41	7.30	1.24	1.59	0.96	0.29	4.16	1.69	30.85
1948	2.69	1.57	2.79	3.54	8.66	3.10	3.73	2.43	—	3.02	—	—	—
Av. 12 yrs.	3.51	2.59	4.09	3.30	3.59	4.54	3.96	3.12	3.18	2.98	4.03	3.90	42.79

MACHIAS, ME.
Record: September, 1926, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	4.37	3.56	7.73	3.57	1.45	7.74	2.89	2.14	4.79	4.06	4.62	2.88	49.80
1943	1.58	3.45	5.72	2.49	5.14	3.96	5.41	7.01	4.34	7.69	5.45	1.33	53.57
1944	1.10	5.24	4.75	2.95	0.43	4.08	1.99	1.05	7.67	5.67	4.43	6.01	45.37
1945	4.29	4.19	3.07	4.03	9.00	4.78	2.01	1.75	3.35	5.81	6.23	3.65	52.16
1946	3.98	5.55	2.51	4.68	4.21	0.67	3.02	2.94	0.85	3.28	3.26	6.63	41.58
1947	3.45	5.03	3.41	1.91	6.58	5.82	3.58	0.51	2.42	0.48	5.25	3.44	41.88
1948	5.01	2.37	3.90	3.24	6.91	2.49	7.11	1.14	1.26	3.45	6.49	3.50	46.87
1949	7.75	5.25	2.97	3.17	3.33	1.82	1.02	1.88	6.99	1.63	7.30	3.36	46.47
1950	4.90	3.80	2.91	4.84	0.59	5.66	2.17	5.28	1.80	2.06	11.85	8.98	54.84
Av. 24 yrs.	4.25	3.42	4.13	3.99	3.21	3.74	3.10	2.76	4.28	4.01	4.63	4.31	45.83

MADISON, ME.—Elevation, 257 feet
Record: January, 1894, to October, 1894; January, 1902, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	2.54	2.81	5.84	2.84	2.26	4.46	1.03	2.12	3.17	1.63	2.94	4.54	36.18
1943	1.21	2.44	2.71	2.62	4.33	5.21	3.51	4.15	1.47	5.77	8.45	1.11	42.98
1944	1.12	3.07	3.77	2.58	0.83	2.30	3.05	1.16	6.25	3.09	5.44	2.88	35.54
1945	4.33	3.31	1.65	4.77	5.73	2.36	4.67	1.80	3.28	3.17	4.44	3.96	43.47
1946	3.70	2.14	1.16	3.15	2.88	1.26	3.70	4.38	4.41	3.72	2.69	4.02	37.21
1947	2.72	3.16	2.49	1.23	4.76	3.78	4.75	1.22	2.22	0.05	4.33	1.74	32.45
1948	2.16	0.95	2.23	2.71	7.25	2.16	2.13	1.54	0.47	3.09	6.47	3.97	35.13
1949	3.00	2.44	1.55	3.06	2.50	2.90	3.42	1.35	3.20	2.11	3.73	1.93	31.19
1950	4.82	—	—	2.80	1.16	5.84	1.35	3.80	1.51	2.00	5.64	4.79	—
Av. 48 yrs.	3.22	2.72	3.43	3.58	3.51	3.36	3.50	3.45	3.78	3.41	3.57	3.21	40.74

MIDDLE DAM, OXFORD COUNTY, ME.—Elevation 1,430 feet
Record: January, 1905, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	1.71	2.76	4.89	3.22	4.03	7.31	2.18	2.31	5.44	2.04	3.94	3.58	43.41
1943	1.30	2.33	2.33	2.74	4.07	7.99	3.88	5.99	4.52	5.18	7.41	1.60	49.34
1944	2.20	2.20	2.17	2.48	1.55	5.63	5.15	3.26	4.36	3.58	3.98	2.97	39.53
1945	3.48	2.42	1.75	5.18	6.16	2.14	4.08	4.10	6.12	4.11	4.77	2.40	46.71
1946	3.46	2.27	0.94	2.10	3.70	3.70	3.36	5.48	3.50	3.28	2.42	3.44	37.65
1947	2.65	3.64	2.72	2.01	5.36	5.29	4.50	1.27	3.22	1.88	4.38	0.97	37.89
1948	1.53	1.66	2.27	2.14	5.45	2.01	3.42	1.72	0.91	2.55	5.40	2.69	31.75
1949	1.94	1.53	2.40	2.42	2.57	3.98	3.20	1.67	2.59	2.19	2.19	1.87	28.56
1950	3.18	1.77	3.13	2.15	0.80	5.62	2.58	4.61	2.15	1.89	5.14	2.70	35.72
Av. 46 yrs.	2.29	1.98	2.57	2.76	3.52	3.91	3.92	3.69	3.79	3.16	3.21	2.34	37.14

MILLINOCKET, ME.—Elevation 386 feet
Record: January, 1900, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	2.46	2.38	5.30	2.13	3.52	5.19	2.09	4.18	3.83	2.80	3.18	3.85	40.87
1943	1.17	2.87	3.88	2.61	2.50	5.35	2.79	4.56	2.44	5.15	5.83	0.72	39.87
1944	0.07	2.51	2.81	1.45	2.26	3.90	2.29	3.15	7.36	5.57	4.00	4.34	39.71
1945	3.83	2.23	1.41	4.91	4.39	1.99	3.91	1.54	4.40	4.31	3.15	2.40	38.47
1946	2.72	1.95	1.23	3.27	2.92	1.19	2.90	4.95	2.99	2.43	3.89	4.13	34.57
1947	2.82	3.24	3.80	2.78	4.44	4.22	5.71	3.37	3.05	0.22	4.00	1.44	39.09
1948	2.39	0.88	2.91	3.42	5.85	2.86	3.30	—	1.16	3.73	6.39	2.28	—
1949	3.98	2.14	2.24	2.75	—	3.06	2.68	—	3.33	2.28	4.46	2.00	—
1950	3.80	2.37	3.20	3.48	0.52	5.55	4.96	5.15	0.97	2.19	10.72	6.62	49.53
Av. 49 yrs.	3.35	2.72	3.47	3.25	3.11	3.75	3.65	3.71	3.77	3.79	3.88	3.51	41.96

MILLINOCKET, ME. (Airport)
Record: January, 1941, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1941	1.82	1.10	2.07	0.38	2.18	—	3.25	3.99	2.18	3.22	3.20	—	—
1942	2.56	1.91	4.71	1.48	3.33	4.58	2.05	4.51	3.68	2.35	3.06	3.74	37.96
1943	1.73	2.78	2.86	2.81	2.47	4.91	2.51	4.45	1.98	5.11	5.08	0.80	37.49
1944	0.12	2.09	2.63	1.51	1.77	3.66	2.12	2.57	7.68	5.56	4.06	3.15	36.92
1945	3.86	2.18	1.61	4.82	4.47	2.12	4.19	1.59	4.46	3.93	3.29	2.11	38.63
1946	2.39	2.24	1.50	3.74	3.58	1.38	3.25	4.69	3.28	2.53	4.80	3.86	37.24
1947	2.63	2.71	3.13	Inc.	Inc.	4.75	5.60	3.25	3.06	0.24	3.81	1.32	—
1948	2.48	1.33	2.74	2.46	5.64	2.65	3.38	4.95	1.08	3.38	7.00	3.19	40.28
1949	4.60	2.43	3.27	2.82	2.65	2.89	2.85	2.61	4.34	2.24	4.62	2.25	37.57
1950	4.19	2.07	2.76	3.34	0.75	5.20	4.76	5.10	1.04	2.28	10.28	6.25	48.02
Av. 8 yrs.	2.74	2.13	2.76	2.87	3.08	3.42	3.14	3.81	3.44	3.42	5.27	3.17	39.25

MILO, ME.
Record: August, 1921, to August, 1949

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	2.41	2.75	5.42	2.56	3.78	5.34	1.65	1.31	—	2.35	3.10	4.02	—
1943	1.31	2.63	3.13	2.22	3.95	6.22	3.18	4.04	2.18	8.18	7.59	1.05	45.68
1944	0.16	3.02	3.13	2.54	0.91	4.48	1.45	0.50	6.11	4.48	3.38	4.62	34.78
1945	4.01	2.23	1.49	5.54	6.10	2.72	2.92	1.39	5.82	3.72	3.50	2.42	41.86
1946	2.51	2.74	1.22	4.02	4.38	1.33	2.94	4.28	2.35	3.70	3.99	4.43	37.89
1947	2.76	4.07	3.03	1.45	5.27	5.35	4.27	1.58	2.80	0.09	4.09	1.33	36.09
1948	2.25	1.01	2.66	2.77	7.22	1.92	5.66	2.28	1.49	3.72	6.16	2.62	39.76
1949	4.32	2.55	2.72	3.11	3.14	2.11	2.43	2.41	—	—	—	—	—
Av. 26 yrs.	2.57	1.96	2.37	2.94	3.63	3.93	3.33	3.30	3.84	4.01	3.90	2.62	38.40

MONMOUTH, ME. (Highmoor Farm)
Record: May, 1939, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1939	—	—	—	—	0.84	2.09	3.30	4.26	3.79	2.08	—	—	—
1940	—	—	—	—	3.00	3.95	3.43	1.98	4.66	0.32	—	—	—
1941	—	—	—	—	2.84	1.00	4.21	4.12	1.04	2.90	—	—	—
1942	—	—	—	—	2.46	6.60	3.04	1.22	3.32	2.13	—	—	—
1943	—	—	—	—	6.23	2.88	3.74	4.43	1.78	7.26	6.13	—	—
1944	—	—	3.68	3.01	0.30	6.40	2.87	1.30	6.05	4.36	6.91	2.73	—
1945	4.06	2.90	1.71	4.74	6.65	6.09	4.74	3.05	2.47	4.48	3.78	3.81	48.48
1946	2.18	2.34	0.85	2.34	3.27	1.69	4.12	6.03	5.73	1.62	3.09	3.78	37.04
1947	4.34	2.52	1.45	1.19	4.81	3.63	3.86	0.45	2.45	0.36	4.78	1.33	31.17
1948	2.60	1.21	2.25	2.57	7.38	3.01	2.21	1.75	1.15	3.08	7.05	4.47	38.73
1949	4.00	3.00	3.08	4.07	3.15	2.65	1.04	1.71	4.18	2.38	4.75	1.76	35.77
1950	4.13	2.32	4.41	3.03	1.19	4.11	1.54	3.64	1.89	3.04	5.55	4.58	39.43
Av. 6 yrs.	3.55	2.38	2.29	2.99	4.41	3.53	2.92	2.77	2.98	2.49	4.83	3.29	38.43

MOOSEHEAD, ME.—Elevation 1,028 feet
Record: September, 1930, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	2.44	1.41	2.80	1.00	2.01	2.11	4.42	4.29	1.92	3.11	2.85	1.87	30.23
1943	1.16	1.92	3.30	3.71	3.00	6.78	2.89	3.67	1.79	8.45	7.06	0.91	44.64
1944	1.22	2.07	2.47	2.33	1.74	3.51	2.71	3.31	4.77	3.31	1.51	4.19	33.14
1945	3.69	1.91	1.24	5.41	4.87	1.52	5.72	2.70	4.66	3.68	3.31	2.69	41.40
1946	3.46	2.12	1.36	3.34	2.96	2.13	2.58	2.61	1.18	6.70	2.81	3.23	34.48
1947	1.81	4.24	2.27	1.90	3.67	3.96	6.35	1.33	2.92	0.56	3.71	1.09	33.81
1948	1.43	0.89	2.42	1.94	7.15	0.84	3.14	3.14	1.19	3.97	5.45	2.14	33.70
1949	2.03	2.15	1.63	2.09	2.77	2.26	3.00	3.33	2.92	1.62	3.49	1.36	28.65
1950	2.96	1.81	4.12	2.55	0.80	5.59	4.13	4.93	1.64	3.07	8.28	4.30	44.18
Av. 20 yrs.	2.50	2.00	2.73	3.06	3.03	3.70	4.14	3.18	3.31	3.45	3.35	2.61	37.06

OLD TOWN, ME.—Elevation 95 feet
Record: March, 1913, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	3.22	2.89	6.23	3.61	2.35	6.28	3.38	1.30	3.70	1.71	4.04	3.48	42.19
1943	1.23	2.14	3.24	2.09	4.02	4.11	2.57	3.88	2.95	7.88	7.47	1.17	42.75
1944	0.38	3.44	3.37	2.43	1.64	3.17	2.00	0.94	7.41	4.56	5.81	3.31	38.46
1945	4.65	2.95	2.51	5.44	7.23	3.87	2.77	1.56	2.63	4.00	4.01	2.97	44.59
1946	3.67	2.90	1.59	3.46	3.07	2.21	2.51	4.15	2.09	2.65	3.77	3.89	35.96
1947	2.77	3.26	2.98	2.15	5.79	5.16	4.86	1.24	3.54	0.20	4.03	1.63	37.61
1948	2.36	1.10	2.44	2.46	5.33	2.24	1.73	0.96	1.28	3.26	5.72	2.58	31.46
1949	3.95	2.49	2.17	2.82	3.37	2.11	3.56	1.01	4.43	2.56	4.89	2.49	35.85
1950	3.64	1.66	2.76	4.17	0.55	2.76	2.08	4.25	1.14	2.47	9.48	5.52	40.48
Av. 37 yrs.	3.06	2.55	3.02	3.43	3.14	3.51	3.39	2.80	3.45	3.81	3.79	3.20	39.15

OQUOSSOC, ME.—Elevation 1,534 feet
Record: January, 1900, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	1.33	2.58	4.35	2.92	1.53	7.02	1.61	1.64	4.79	1.59	2.96	4.80	37.12
1943	1.07	2.26	2.18	1.92	2.72	7.58	1.46	4.97	2.66	3.98	5.79	1.64	38.23
1944	2.63	2.10	2.10	2.28	1.40	3.56	5.48	3.13	3.20	3.43	3.10	3.00	35.41
1945	3.54	2.16	2.34	3.73	5.69	2.28	4.23	1.35	5.33	4.72	2.76	3.05	41.18
1946	3.63	3.25	1.10	2.64	3.11	1.56	3.06	4.72	4.36	2.51	2.02	3.76	35.72
1947	2.09	5.61	1.76	1.53	5.32	2.94	3.17	0.89	1.83	0.71	3.07	1.35	30.27
1948	1.61	1.29	2.40	1.46	7.50	0.87	2.09	2.01	1.23	2.63	4.91	3.34	31.34
1949	2.13	1.83	1.77	1.75	2.39	3.32	3.02	1.98	2.04	1.89	2.53	2.09	26.74
1950	6.39	1.51	2.43	1.75	0.48	4.56	1.40	5.63	1.18	1.66	5.86	2.45	35.30
Av. 42 yrs.	2.85	2.38	2.86	2.69	3.07	3.43	3.38	3.19	3.54	2.94	3.39	2.68	36.40

PORTLAND, ME.—Elevation 99 feet
Record: June, 1856, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	3.20	3.92	7.55	2.17	1.77	5.94	5.01	1.06	1.28	2.55	4.71	4.99	44.15
1943	2.14	2.81	2.43	3.34	6.09	2.42	3.78	3.27	1.64	6.55	5.56	1.00	41.03
1944	2.28	3.98	5.10	3.90	1.00	5.42	3.03	0.59	6.79	2.36	6.59	3.74	44.78
1945	3.88	3.92	1.86	3.28	6.77	5.84	2.56	1.25	3.84	5.52	5.10	5.95	49.77
1946	3.74	2.61	1.07	2.71	3.50	1.67	2.22	8.30	2.90	1.49	2.10	4.49	36.80
1947	4.02	2.34	2.72	2.69	4.37	3.92	3.06	0.27	1.73	0.26	4.87	1.96	32.21
1948	2.61	1.79	2.48	2.95	7.41	4.52	1.20	—	—	—	—	—	—
1949	5.00	3.22	2.37	3.71	3.44	2.40	2.07	1.58	6.21	2.37	4.63	1.82	38.82
1950	4.59	2.65	4.92	2.20	1.69	1.68	1.09	4.79	1.83	1.89	5.95	3.91	37.19
Av. 81 yrs.	4.03	3.75	3.93	3.48	3.35	3.27	3.25	3.17	3.20	3.26	3.61	3.77	42.07

PRESQUE ISLE, ME.—Elevation, 1,000 feet
Record: 1909 to December, 1950

Year	Jan.,	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	1.45	2.42	3.14	1.06	1.47	3.17	1.92	4.13	3.11	1.31	1.68	3.18	28.04
1943	0.46	1.96	2.29	1.60	2.08	4.23	3.74	4.41	2.20	6.45	3.88	0.46	33.76
1944	0.08	1.36	1.31	1.17	1.46	4.28	3.07	1.42	4.39	7.10	2.31	2.48	30.43
1945	2.98	1.06	1.22	3.86	4.76	3.14	5.36	2.95	5.20	2.34	2.82	1.42	37.11
1946	2.64	2.28	1.88	2.57	3.29	1.95	3.77	3.22	0.66	3.14	3.61	2.14	31.15
1947	1.74	3.12	1.78	2.66	6.00	4.43	4.73	2.30	3.15	0.51	2.61	1.08	34.11
1948	1.22	0.74	1.87	1.92	4.42	2.86	2.32	2.70	2.58	4.82	4.27	1.82	31.04
1949	2.37	1.81	—	1.80	3.74	2.75	3.94	2.80	4.64	1.96	4.51	1.50	—
1950	1.49	1.73	2.26	2.43	0.90	6.16	2.94	3.89	1.09	1.80	7.15	5.57	37.41
Av. 35 yrs.	2.08	1.88	2.15	2.47	3.03	3.79	3.75	3.16	3.27	3.39	2.65	2.43	34.05

RIPOGENUS DAM, ME.
Record: January, 1925, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	1.58	2.16	4.27	2.48	3.63	5.21	2.89	5.77	3.80	2.66	3.15	1.95	39.55
1943	0.75	2.09	2.55	2.03	2.48	8.78	5.07	3.65	3.22	6.41	4.32	0.64	41.99
1944	1.43	2.34	1.58	1.68	4.44	4.43	4.73	5.78	4.53	3.96	1.84	3.81	40.55
1945	3.38	2.83	1.71	5.27	5.30	3.20	4.91	1.49	5.40	4.64	4.23	1.87	44.23
1946	3.68	2.09	1.53	3.38	3.06	1.65	4.38	4.18	3.90	2.05	4.05	3.79	37.74
1947	2.21	5.62	3.94	2.98	5.13	4.77	4.06	1.79	2.75	0.55	5.66	1.36	40.82
1948	2.06	1.22	3.04	2.58	6.99	1.19	3.76	2.24	2.27	4.63	6.19	2.77	38.94
1949	3.04	1.81	2.59	3.09	3.58	2.89	4.13	2.63	2.48	2.29	3.59	1.97	34.09
1950	3.76	2.22	4.06	3.37	0.84	4.83	2.14	4.76	0.84	2.77	9.21	5.87	44.67
Av. 26 yrs.	2.56	2.08	2.81	3.28	3.85	4.27	3.99	3.83	3.97	4.07	3.92	2.77	41.40

ROCKLAND, ME.
Record: January, 1939, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	3.77	3.20	6.92	3.58	2.26	5.92	3.62	2.11	3.12	3.04	4.91	3.56	46.01
1943	1.67	2.85	3.56	3.20	5.64	2.09	6.97	5.15	2.62	9.86	6.50	1.61	51.72
1944	1.70	3.96	5.19	3.58	0.89	3.91	2.50	0.83	7.31	2.59	6.82	3.69	42.97
1945	4.74	3.87	2.13	4.65	8.16	5.32	2.18	1.65	3.65	4.03	5.56	4.05	49.99
1946	4.64	4.02	1.44	3.39	3.57	1.44	2.93	4.51	4.00	2.35	4.51	5.70	42.50
1947	3.92	3.16	3.65	1.44	6.52	3.55	2.42	0.26	1.68	0.14	5.76	2.97	35.47
1948	3.09	1.92	3.12	3.34	7.17	4.47	1.63	0.22	0.42	3.51	6.03	3.54	38.46
1949	4.70	4.55	2.36	2.80	3.40	3.25	1.08	0.89	5.56	3.09	5.00	2.44	39.12
1950	5.62	3.84	3.56	3.59	1.02	2.62	1.42	4.09	2.00	2.64	8.50	6.25	45.15
Av. 12 yrs.	3.49	3.27	3.85	3.62	3.82	3.41	2.71	2.13	3.32	3.37	5.66	3.78	42.43

ROXBURY, ME.
Record: January, 1944, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1944	1.62	2.46	2.57	2.62	1.20	5.05	4.02	2.10	4.95	3.14	4.53	3.55	37.81
1945	3.22	2.49	1.39	4.05	5.91	3.45	3.09	5.93	4.14	5.87	4.63	3.53	47.70
1946	2.42	1.03	1.15	3.40	3.73	2.82	2.76	5.64	5.21	3.43	2.82	4.04	38.45
1947	3.31	3.57	2.54	1.70	4.79	4.38	5.07	1.47	1.67	0.52	3.79	1.50	34.31
1948	1.84	1.28	2.29	2.96	6.43	2.58	1.70	3.01	0.68	4.10	6.96	3.02	36.85
1949	2.56	5.26	1.11	3.22	3.84	3.95	3.72	2.30	4.01	2.14	4.02	1.53	37.66
1950	4.52	2.12	4.41	4.36	1.39	5.60	2.31	4.19	1.03	2.61	7.12	3.85	43.60
Av. 7 yrs.	2.78	2.60	2.21	3.19	3.90	3.99	3.24	3.52	3.10	3.11	4.84	3.00	39.48

RUMFORD FALLS, ME.—Elevation 505 feet
Record: January, 1894, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	2.73	2.22	5.25	1.75	1.69	7.35	5.85	1.82	3.44	2.16	3.46	4.19	41.91
1943	1.23	1.79	2.37	3.42	4.18	3.04	3.30	4.01	2.69	6.67	7.07	0.38	40.60
1944	1.53	2.79	3.01	2.94	1.06	4.43	3.53	1.18	4.47	2.60	5.22	3.13	35.89
1945	4.30	2.31	1.64	3.71	7.12	4.72	4.86	1.94	2.53	4.89	4.32	3.77	46.91
1946	3.40	2.11	0.91	3.04	3.23	1.64	2.15	6.44	5.97	2.11	2.64	3.81	37.45
1947	3.25	3.82	3.00	1.27	4.68	5.63	6.20	1.23	1.73	0.04	4.85	1.59	37.29
1948	2.06	1.19	2.61	3.38	6.18	1.31	1.24	2.08	0.33	2.58	5.42	4.32	32.70
1949	2.78	2.30	1.31	2.61	2.53	3.58	1.83	2.05	2.47	1.89	3.77	1.64	28.76
1950	3.83	2.17	3.45	4.04	0.69	4.02	1.66	4.14	1.50	2.49	8.25	3.87	40.11
Av. 57 yrs.	2.93	2.67	3.32	3.21	3.30	3.49	3.67	3.31	3.53	3.13	3.56	3.00	39.12

RUMFORD, ME.
Record: June, 1941, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1941	—	—	—	—	—	1.48	4.46	3.33	2.36	2.31	2.73	3.90	—
1942	2.94	2.37	5.48	2.13	1.76	8.02	5.48	1.84	3.61	2.37	3.73	—	—
1943	3.40	1.80	2.47	3.38	4.55	3.15	3.57	4.22	2.76	6.78	6.90	0.75	43.73
1944	1.48	2.72	3.15	2.76	1.15	4.26	3.66	1.29	4.57	2.80	5.45	2.99	36.28
1945	4.02	2.51	1.78	4.11	6.74	5.08	4.05	2.18	2.70	4.87	4.85	4.44	47.33
1946	3.06	1.78	0.91	2.72	3.00	1.67	2.35	6.50	6.06	2.26	2.79	3.80	36.90
1947	3.21	4.11	2.44	1.54	—	5.52	6.45	1.17	1.92	0.07	5.12	1.55	—
1948	1.68	0.75	2.30	4.05	6.44	2.16	2.22	2.39	0.64	2.90	6.01	4.53	36.17
1949	2.49	1.95	1.69	3.04	3.78	4.28	2.50	2.22	3.40	2.39	4.51	2.19	34.44
1950	3.59	2.45	4.26	4.42	1.19	7.20	2.27	4.35	2.47	3.22	9.02	4.82	49.26
Av. 7 yrs.	2.82	1.99	2.37	3.50	3.84	3.97	2.94	3.31	3.23	3.60	5.65	3.37	40.59

SQUA POND DAM, ME.
Record: 1928 to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	1.71	3.18	4.03	1.40	1.84	4.85	2.44	3.75	3.07	1.70	2.24	3.63	33.84
1943	1.13	2.56	2.10	2.39	2.72	4.44	4.16	3.70	3.14	4.78	3.47	0.89	35.48
1944	0.21	1.81	2.67	1.12	1.57	3.64	3.48	1.92	3.59	5.20	2.13	1.64	28.98
1945	2.70	2.02	1.93	4.00	4.49	3.17	6.18	2.08	5.69	2.63	2.78	2.12	39.79
1946	2.45	2.17	1.80	2.91	3.41	2.93	3.60	2.87	1.59	1.86	3.80	2.46	31.85
1947	1.76	2.11	2.00	3.80	4.56	4.10	3.14	2.33	3.10	0.60	3.02	0.62	31.14
1948	1.40	1.12	2.26	2.78	4.65	2.61	2.46	3.28	1.75	5.17	4.89	1.92	34.29
1949	2.71	2.01	2.85	2.57	3.41	2.65	2.78	4.90	3.35	1.61	4.79	2.07	35.70
1950	2.66	2.32	2.78	3.16	1.16	5.53	3.80	4.79	1.25	2.02	6.76	5.53	41.71
Av. 15 yrs.	2.14	2.09	2.66	2.66	3.19	4.05	3.67	3.42	3.22	3.27	3.37	2.57	36.31

SWANS FALLS, ME.
Record: December, 1940, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1940	—	—	—	—	—	—	—	—	—	—	—	3.78	—
1941	1.43	2.09	1.28	0.21	2.70	1.90	6.45	2.79	1.46	2.63	3.11	3.34	29.39
1942	3.44	2.20	5.52	1.61	1.60	7.01	3.30	0.99	3.05	2.42	4.90	3.96	40.00
1943	1.78	2.17	2.26	4.25	3.90	3.48	5.41	4.01	2.03	5.64	6.76	0.72	42.41
1944	0.96	3.01	3.91	3.70	1.00	7.57	7.00	0.88	6.07	2.94	4.86	2.87	44.77
1945	3.20	3.30	1.99	4.10	7.44	6.59	3.96	1.89	3.21	4.31	4.47	4.86	49.32
1946	2.99	1.79	1.14	2.30	3.80	3.58	3.59	9.44	5.18	1.59	2.66	3.81	41.87
1947	4.05	1.71	2.92	2.03	5.42	6.38	3.79	0.46	1.53	0.22	4.53	1.45	34.40
1948	2.82	1.41	2.28	3.56	6.91	3.01	2.40	1.30	0.42	2.87	5.89	5.72	38.59
1949	4.21	2.17	1.95	3.23	3.60	1.26	1.07	2.70	3.12	2.12	3.48	2.05	30.96
1950	4.60	2.71	3.94	3.62	1.44	4.27	0.84	6.23	1.63	2.79	8.79	4.86	45.72
Av. 10 yrs.	2.95	2.26	2.72	2.86	3.78	4.50	3.77	3.07	2.77	2.75	4.95	3.36	39.74

THE FORKS, ME.—Elevation 580 feet
Record: January, 1902, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	1.61	2.23	4.16	2.72	2.31	5.99	2.41	3.49	4.20	2.06	3.09	4.14	38.41
1943	1.00	1.71	2.70	2.48	3.53	6.22	2.18	4.00	2.28	6.30	6.42	0.72	39.54
1944	1.89	2.26	2.18	2.30	1.26	2.75	2.35	2.68	3.70	2.75	1.72	3.41	29.35
1945	3.51	1.89	1.98	4.65	5.32	3.22	5.55	1.03	4.37	3.93	4.21	2.23	41.89
1946	2.86	2.04	0.83	3.58	2.52	2.04	3.60	3.51	1.92	6.05	2.48	3.34	34.77
1947	1.91	3.84	2.77	1.51	3.90	3.81	5.68	0.84	2.30	0.70	3.94	1.02	32.22
1948	1.82	0.84	2.50	1.94	6.67	1.27	4.43	2.62	1.42	3.19	4.84	2.42	33.96
1949	2.81	1.84	1.36	2.28	2.49	1.89	1.78	2.02	2.44	1.80	3.62	1.55	25.88
1950	3.50	2.12	4.09	2.29	0.75	6.60	2.38	4.65	0.86	2.58	6.69	3.73	40.24
Av. 39 yrs.	2.63	2.21	2.77	3.10	3.30	3.71	3.89	3.03	3.30	3.33	3.35	2.56	37.18

UPPER DAM, ME.—Elevation 1,470 feet
Record: January, 1886, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	1.20	1.74	3.49	2.92	2.06	6.49	2.27	2.24	4.86	1.83	3.10	3.71	35.91
1943	0.92	1.62	2.59	2.45	3.20	8.86	2.66	5.76	2.79	4.05	6.77	1.65	43.32
1944	2.38	1.99	1.92	2.53	1.47	4.55	7.43	3.60	3.73	3.85	3.92	2.75	40.12
1945	3.20	2.06	2.23	3.93	5.38	2.86	3.69	2.28	6.05	2.88	4.62	2.30	42.48
1946	3.08	1.90	1.28	2.46	3.54	2.78	3.32	4.19	4.04	2.85	3.47	3.85	36.76
1947	2.79	2.92	2.11	1.93	5.18	5.03	3.85	1.93	2.76	1.05	4.01	1.30	34.86
1948	1.94	1.64	2.28	2.43	5.98	1.94	2.43	1.99	1.62	2.65	5.81	3.06	33.77
1949	2.30	1.92	2.39	2.59	2.78	4.35	3.17	1.48	2.49	1.95	2.56	2.74	30.72
1950	4.06	1.63	3.28	2.39	1.10	5.70	2.13	7.73	1.85	1.78	6.39	2.78	40.82
Av. 65 yrs.	2.46	1.99	2.60	2.38	3.04	3.45	3.43	3.22	3.29	2.61	3.02	2.47	33.96

WINSLOW, ME.—Elevation 90 feet
Record: January, 1896, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	3.05	1.91	5.47	1.93	2.07	4.89	3.15	1.14	3.60	2.41	2.94	4.01	36.57
1943	1.34	2.19	2.28	2.16	4.99	2.66	4.87	3.76	2.58	6.33	7.13	1.06	41.35
1944	0.84	2.93	3.24	2.64	0.68	3.03	5.35	1.94	5.65	4.18	3.55	2.24	36.27
1945	3.53	2.33	1.74	5.71	6.36	3.17	2.78	2.26	3.11	3.47	4.09	3.27	41.82
1946	2.81	2.50	0.53	2.42	3.06	1.26	3.69	5.03	2.26	6.28	2.80	3.96	36.60
1947	2.71	2.94	2.43	1.08	5.14	3.79	6.71	1.61	2.49	0.49	4.26	1.47	35.12
1948	2.03	1.03	2.58	2.74	7.52	3.01	2.64	0.95	0.81	3.82	6.48	3.07	36.68
1949	3.48	2.60	1.77	2.94	2.34	3.95	1.92	1.43	3.75	2.55	5.19	1.53	33.45
1950	3.72	2.24	3.34	3.08	0.84	2.45	2.07	3.92	2.02	2.32	8.89	5.27	40.16
Av. 55 yrs.	2.86	2.33	3.12	3.01	3.18	3.05	3.57	3.19	3.63	3.48	3.35	2.82	37.59

EAST WINTHROP, ME.
Record: August, 1931, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	2.21	2.72	6.17	3.15	1.81	5.46	3.71	1.66	3.13	2.28	3.44	4.75	40.49
1943	1.67	2.33	2.38	2.18	5.73	2.24	3.36	3.69	1.69	6.46	6.17	0.93	38.83
1944	1.67	3.59	3.43	3.06	0.68	4.71	2.70	1.52	6.56	3.43	3.02	3.30	37.67
1945	4.82	2.99	1.75	5.23	6.41	4.15	5.10	2.09	2.63	4.00	4.84	3.75	47.76
1946	3.01	3.49	1.02	2.91	3.43	1.52	2.95	5.86	3.83	2.72	2.95	4.41	38.11
1947	3.66	2.92	2.82	1.19	4.69	3.45	3.85	0.64	2.74	0.16	4.74	2.25	33.11
1948	3.27	1.46	2.42	2.75	7.51	3.48	1.42	1.28	0.55	3.31	6.38	4.42	38.25
1949	4.10	2.81	2.45	3.59	3.09	2.46	1.11	1.03	4.69	2.76	4.41	1.59	34.09
1950	4.80	2.84	4.18	2.99	0.79	2.51	2.00	3.52	1.89	2.15	6.68	4.81	39.36
Av. 19 yrs.	3.51	2.73	3.28	3.49	3.22	2.98	3.44	2.70	4.21	3.16	3.99	3.49	40.20

WOODLAND, ME.
Record: January, 1920, to December, 1950

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1942	3.02	3.10	7.78	2.19	2.26	5.82	2.27	1.82	4.17	3.81	3.97	3.48	43.69
1943	1.00	2.17	2.81	3.23	3.78	4.91	3.23	5.16	3.21	8.17	7.48	1.05	46.20
1944	0.54	2.73	3.69	2.53	1.77	4.22	2.64	1.81	7.06	6.76	4.51	3.69	41.95
1945	4.53	2.70	2.93	3.96	6.77	3.66	2.46	1.22	3.46	5.51	5.75	3.40	46.35
1946	2.32	4.20	1.79	3.86	3.76	1.05	1.71	3.11	2.52	2.20	3.27	3.91	33.70
1947	2.93	4.54	3.02	1.86	5.71	4.65	4.41	1.16	2.46	0.57	5.23	1.88	38.42
1948	2.83	1.44	2.43	2.43	7.25	2.04	3.63	1.98	0.97	3.59	5.79	4.37	38.75
1949	3.45	3.01	2.78	2.79	2.91	2.35	2.23	2.74	6.48	2.26	6.51	2.52	40.03
1950	3.65	3.26	3.00	5.11	0.67	3.61	3.48	6.92	1.29	2.45	12.61	7.87	53.92
Av. 31 yrs.	3.12	2.54	3.31	3.49	2.98	3.24	2.78	3.05	3.78	4.39	4.32	3.50	40.45

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1955-1956

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MEMOIR OF LELAND G. CARLTON

Leland Carlton, Past President of the New England Water Works Association, died at Springfield, Mass., on June 11, 1955, after a long illness. He is survived by his wife, Mrs. C. H. (Adams) Carlton, and a niece and a nephew.

He was born in Brattleboro, Vt., 70 years ago, the son of Andrew Gardner and Cynthia (Leland) Carlton.

Following graduation from Brattleboro High School young Carlton entered the University of Vermont, from which he graduated in 1906 with a B.S. degree in Civil Engineering. After graduation from the University he went to Springfield to work on the Little River water-supply project. During his entire professional career he was connected with the Springfield Water Works, until his retirement in September, 1954. He became Superintendent of the system in 1940 after serving successively as Assistant Engineer, Assistant Chief Engineer, Assistant Superintendent, and Registrar. During his services with the Springfield Water Department, the Ludlow and Cobble Mountain systems were developed. In World War I, he was a Captain in the Army Quartermaster Corps, in supervision of water supplies.

Mr. Carlton was a Mason and had held many offices in that fraternity. He had received the honorary 33rd degree of that order, and was a member of the Supreme Council of Scottish Rite Masons and of Melhar Temple Shrine. He was a member of the Faith Congregational Church in Springfield, of Post 21, American Legion, and was the Vice President of the Springfield Kiwanis Club.

He joined the New England Water Works Association in March, 1907, and had been a loyal and active member over the many years. He served on numerous committees and was Treasurer during the period 1933-1938. His term of office as President was 1940-41. He was a member of the American Water Works Association and of the Engineering Societies of Western Massachusetts, of which he was a Past President.

Those of us who knew Leland Carlton over the years will sorely miss him at our monthly and annual meetings. He was a genial, kindly man of personal and professional integrity of character, who served his city faithfully and well. The New England Water Works Association and the water-works profession have lost a valued member. Those of us who were privileged to know him well have lost a friend who will be remembered with deep affection.

E. SHERMAN CHASE

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E. SHERMAN CHASE

BOOK REVIEW

ELEMENTS OF HYDRAULIC ENGINEERING. *By Ray K. Linsley, Jr., and Joseph B. Franzini.* 582 pp. New York, N. Y.: McGraw-Hill Book Co., Inc., 1955. $9.00.

This volume, one of the McGraw-Hill Series in Civil Engineering, is a textbook for an introductory course in hydraulic engineering. The authors stress the fundamentals of the subject and present a minimum of detail on physical construction. Hydraulic engineering is discussed as a unified field, by emphasizing the similarities between the various subfields rather than the differences.

Part I deals with hydrologic and legal considerations which are common to all hydraulic projects. Part II discusses the structures required for such projects, together with the elements of engineering economy pertinent to hydraulic design. Part III discusses the special problems of the various branches of hydraulic engineering. As an example of the content of Part III, it might be mentioned that there is a brief exposition of each of the common methods of water purification and sewage treatment.

The list of chapters is as follows:

1. Introduction.
2. Descriptive Hydrology.
3. Quantitative Hydrology.
4. Groundwater.
5. Frequency Analysis in Hydrology.
6. Water Law.
7. Reservoirs.
8. Dams.
9. Spillways, Gates, and Outlet Works.
10. Open Channels.
11. Pressure Conduits.
12. Hydraulic Machinery.
13. Some Economic Aspects of Hydraulic Projects.

14. Irrigation.
15. Water Supply and Purification.
16. Hydroelectric Power.
17. River Navigation.
18. Drainage.
19. Sewerage and Sewage Treatment.
20. Flood Control.
21. Multiple-purpose Projects.

The book also contains an appendix of physical constants, conversion tables and equivalents, as well as a 12-page index. There are 215 problems for student solution and numerous illustrations. Each chapter contains a bibliography.

GEORGE C. HOUSER

REVISIONS TO STEEL WATER TANK STANDARDS

Revisions to the AWWA-AWS-NEWWA Standard Specifications for Steel Tanks, Standpipes, Reservoirs, and Elevated Tanks for Water Storage, D100-52, and to Tentative Recommended Practice for Painting and Repainting Elevated Steel Water Storage Tanks, Standpipes, and Reservoirs, D102-52T, were approved by the NEWWA Executive Committee on October 21, 1955. Copies of these revised documents will be made available from AWWA headquarters. A general summary of the changes made in the various sections is given below:

AWWA D100-52

1. *2.1 Bolts, Anchor Bolts and Rods*
   A-307 Grade B for bolts has been added. All previously specified rod material has been deleted except A7. Some of those previously permitted had no specified ultimate tensile strength and this therefore eliminated their use for design purposes. A-307 bolting material is not suitable for use as rods particularly where welding is applied, due to the possibiilty of having too high a sulfur content. These were therefore eliminated.
2. *2.3 Plates*
   Alternative plate materials have been included for use in hazardous locations and for locations with low ambient temperatures.
3. *2.5 Structural Shapes*
   Alternative structural materials have been included for use in hazardous locations and for locations with low ambient temperatures.
4. *2.10.1 Forgings from Plate Materials*
   The heading has been revised and we are including the use of all the plate materials covered in Section 2.3 without enumeration.
5. *2.10.2 Forgings Made from Other Than Plate Materials*
   The heading has been revised.
6. *3.2.3 Snow Loads*
   A sentence has been added, covering permissible deflection of roof plating between roof supports.
7. *3.2.6 Balcony and Ladder Load*
   This has been revised to indicate an area of plating to support the previously specified concentrated loadings. The combination of loadings has been clarified and permission for plate deflection between structural supports has been added.

8. *3.3.1 Tension*
The area of a rod subjected to tension has been clarified.
9. *3.3.4 Shearing*
We have added structural connection materials, which was not covered previously.
10. *3.5.2 Tubular Sections—Columns and Struts*
Have added details for the welded joints.
11. *Table 2*
Have deleted from the title "psi".
12. *3.8 Roof Supports*
Have added the phrase "for rafters in contact with the steel roof."
13. *3.9 Foundation Bolts*
Have changed the word "base" to "root".
14. *3.11 Minimum Thickness*
Minimum thicknesses of tank-shell plates has been prescribed for large diameter tanks.
15. *3.17 Reinforcement around Openings*
The reinforcement of openings in the riser pipes has been added to this section.
16. *3.17.1 Reinforcement of Openings*
100 per cent reinforcement of openings in tanks or riser plating has been prescribed and certain restrictions have been added.
17. *3.17.2 Reinforcement of Openings in Riveted Tanks*
The content of this section has not been revised.
18. *3.17.3 Reinforcement around Openings* (Previous number 3.17.4)
A clarification of the reinforcing requirements has been added.
19. *3.17.6 Reinforcement around Openings* (Previous number 3.17.7.)
The reinforcing requirements have been clarified slightly.
20. *3.17.7 Reinforcement around Openings* (A new section)
This provides for the smoothing and rounding of corners of reinforcing plates for openings.
21. *5.5 Structural Column Splices*
The above heading has been revised.
22. *5.8 Pin Holes* (A new section)
This is a new section covering dimensions of eye bars.
23. *5.12 Steel Riser Pipe* (Previous number 5.11)
The revisions add certain restrictions to the construction of riser pipes, including the joints in the plating.
24. *6.4 Outside Tank Ladder*
The construction of the ladder has been defined.
25. *7.1 Tower Ladders*
The construction of the ladder has been defined.
26. *7.2 Outside Tank Ladder*
The construction of the ladder has been defined.

27. *7.8 Pipe Connections*
A protection has been placed over the inlet pipe, to prevent entry of materials falling from above.
28. *8.2.4 Groove Welds*
Certain references have been added for complete penetration welds when specified.
29. *8.2.6 Qualification of Welders and Welding Operators*
Provision for automatic welding has been included.
30. *8.4 Butt Joints Subject to Secondary Stress*
Certain restrictions have been added in regard to the shell joints.
31. *8.7.2 Butt Joint Construction*
There have been restrictions added regarding the location of three plate joints.
32. *8.8 Shell to Bottom Joint*
There has been added a clarification of the text.
33. *8.10.5* Additional references have been added.
34. *8.11 Minimum Laps for Lap Welded Joints*
All types of lap joints are included in the same requirements.
35. *10.3* Revised references have been added.
36. *10.6 Weather Conditions*
The use of low-hydrogen electrodes has been added.
37. *10.7 Preheating, etc.*
Revised to mention the use of low-hydrogen electrodes.
38. *10.8 Low-Hydrogen Electrodes*
The use of Low-Hydrogen Electrodes has been provided for.
39. *10.10 Tack Welds* (Previous number 10.9)
This section has been revised, to provide for automatic welding of tank shells.
40. *10.12.2* Revised reference has been made. (Previous number 10.11.2)
41. *10.14 Gouging and Melting Out* (Previous number 10.13)
There has been a slight revision in the wording.
42. *11.2 Inspection*
This is a new section regarding shop inspection.
43. *11.3 Field inspection* (Previous number 11.2)
This has been revised, to include radiographic inspection.
44. *11.6.7 Joints Subject to Secondary Stress* (Previous number 11.5.7)
The text has been clarified in regard to the location for taking test segments of the welds.
45. *11.6.8* Revised references have been added. (Previous number 11.5.8)
46. *11.6.9* This is a new section regarding the number of inspection segments to be removed when constructing a group of tanks.
47. *11.9.10* (Previous number 11.8.10)
This has been revised in regard to the method of removing defects from welds.

48. *11.10 Method of Closing Openings* (Previous number 11.9)
Additional requirements have been added in regard to the closing of openings made with a spherical saw.
49. *11.13 Who Pays for the Inspection* (Previous number 11.12)
This section revised, to include both field and shop inspection instead of field inspection only.
50. *12.2.3 Delete the Water Test of Bottom*
51. *12.3 General*
Additional methods for removing defects in welds have been inserted.
52. *Vacuum Testing*
A description of vacuum testing method has been included.
53. *Appendix A*
Change to Appendix B.
54. *Appendix B2.21* (Previous number A2.21)
Revised references.
55. *Appendix B13* (Previous number A13)
References have been renumbered.
56. *Appendix A Procedures for Testing by Radiographic Methods*
This is a new section, covering radiographic inspection of welds.

AWWA D102—52T

These changes defined wax-grease coats, which lacked proper definition, and rescinded the use of cold-applied coal-tar paint CA-50, as it was found that unless thoroughly and slowly dried, it was likely to impart an unpleasant taste to the water. The use of cold-applied coal-tar paint was restricted to parts of tanks above the high water level and the use of cold-applied, tasteless and odorless tar-base paint was permitted on parts of the tank below high water level.

UDC 621.67

ASA B58.1-1955
(AWWA A101-55)

American Standard Specifications

for

DEEP WELL VERTICAL TURBINE PUMPS

Approved by American Standards Association May 11, 1955

Sponsored and Published by

AMERICAN WATER WORKS ASSOCIATION
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ASA B58.1-1955
(AWWA A101-55)

American Standard Specifications for

Deep Well Vertical Turbine Pumps

Section 1—Scope and Purpose

This specification is recommended as a guide for the deep well turbine pump user in selecting new equipment. The suggested standards are to be considered as a minimum requirement for a first-quality deep well turbine pump, but do not preclude the use of more elaborate specifications on the part of either user or manufacturer, nor is it the intent to restrict the use of any equipment not meeting the requirements of this specification should the user not consider such compliance necessary.

This specification is applicable primarily to pumps that are constructed of accepted standard materials of the best quality and workmanship, and handle cold, clear water, usually from an underground well.

Section 2—Definitions

2.1. *A vertical turbine* pump is a vertical-shaft centrifugal or mixed-flow pump with rotating impeller or impellers, with discharge from the pumping element coaxial with the shaft. The pumping element is suspended by the conductor system which encloses a system of vertical shafting used to transmit power to the impellers, the prime mover being external to the flow stream. The unit is used for pumping from open pools or closed suction systems. A basic pump consists of three elements, defined as follows:

2.1.1. *The pump bowl assembly* is either a single or multistage, centrifugal or mixed-flow vertical pump with discharge coaxial with the shaft. It has open, semiopen, or enclosed impellers. Assemblies are constructed for use with either open or enclosed line shafts.

2.1.2. *The column and shaft assembly* consists of the column pipe which suspends the pump bowl assembly from the head assembly and serves as a conductor for the fluid from the pump bowl assembly to the discharge elbow. Contained within the column pipe is the line shaft which transmits the power from the driver to the pump shaft. The line shaft is supported throughout its length by means of bearings and may be enclosed in a shaft-enclosing tube and generally lubricated with oil, or it may be open and lubricated with the fluid being pumped.

2.1.3. *The head assembly* consists of the base from which the column and shaft assembly and the bowl assembly are suspended, the discharge elbow which directs the fluid into the desired piping system, and the driver.

2.1.3.1. *The driver* is the mechanism mounted on the discharge head which transmits the power to the top shaft. It contains means for impeller

adjustment and provides a bearing to carry the thrust load. It may or may not be a prime mover.

2.1.3.2. *In underground discharge,* the discharge elbow is separated from the head assembly and installed in the column pipe at the desired distance below the head assembly.

2.2. *Types of drivers* are defined as follows:

2.2.1. *The vertical hollow-shaft motor drive* is an electric motor having a motor shaft which has been bored on the center of its axis to receive the top shaft of the pump. Impeller adjustment is made at the upper end of the motor, and a means to carry the thrust on a bearing within the motor is provided.

2.2.2. *The vertical hollow-shaft right-angle gear drive* is a gear mechanism having a shaft which has been bored on the center of its axis to receive the top shaft of the pump. The horizontal shaft of a gear drive receives its power from the prime mover and, through a pair of bevel gears, transmits it to the top shaft. Impeller adjustment is made at the upper end of the gear drive, and a means to carry the thrust on a bearing within the gear drive is provided.

2.2.3. *The vertical hollow-shaft belted drive* is a flat- or V-belt driven mechanism having a shaft which has been bored on the center of its axis to receive the top shaft of the pump. Impeller adjustment is made at the upper end of the belted drive, and a means to carry the thrust on a bearing within the belted drive is provided.

2.2.4. *The flexible-coupling drive* is a mechanism having a thrust bearing capable of carrying the pump thrust, providing means of impeller adjustment, and having a flexible coupling. The top of this driver is designed to mount solid-shaft prime movers, including electric motors, steam turbines, radial engines, or any other type of prime mover having a solid shaft and suitable for mounting with the shaft in a vertical position.

2.2.5. *The combination drive* includes means for operating the pump with two or more drivers.

2.3. *The datum* shall be taken as the elevation of that surface from which the weight of the pump is supported. This is normally the elevation of the underside of the discharge head or head base plate.

2.4. *The setting* is the nominal distance in feet from the datum to the column pipe connection at the bowl assembly.

2.5. *The static water level* is the vertical distance in feet from the datum to the level of the free pool while no water is being drawn from the pool.

2.6. *The pumping water level* is the vertical distance in feet from the datum to the level of the free pool while the specified fluid flow is being drawn from the pool.

2.7. *Drawdown* is the difference in feet between the pumping water level and the static water level.

2.8. *Specific yield,* expressed in gpm (US gallons per minute) per foot of drawdown, is the rate of flow from the free pool, divided by the drawdown.

2.9. *The capacity of the pump* is the volume rate of flow (Q), expressed in gpm, produced by the pump, calculated for specified conditions.

2.10. *The pump speed of rotation* (N) is the rate of rotation of the pump shaft, expressed in rpm (revolutions per minute).

2.11. *Head* is a quantity used to express a form (or combinations of forms) of the energy content of the liquid per unit weight of the liquid, referred to any arbitrary datum. In

terms of foot-pounds of energy per pound of liquid, all head quantities have the dimension of feet of liquid.

2.11.1. *Head below datum* (h_b) is the vertical distance in feet between the datum and the pumping water level.

2.11.2. *Head above datum* (h_a) is the head measured above the datum, expressed in feet of liquid, plus the velocity head (Sec. 2.11.3) at the point of measurement.

2.11.3. *Velocity head* (h_v) is the kinetic energy per unit weight of the liquid at a given section. Velocity head is specifically defined by the expression:

$$h_v = \frac{v^2}{2g}$$

2.11.4. *Suction head* (h_s) is the algebraic sum of the pressure head (measured at the elevation of the suction case lower connection) and the velocity head at that point. The value of the suction head is not required when the surface of the liquid being pumped is exposed to atmospheric pressure.

2.11.5. *Pump total head* (H) is the bowl assembly head (Sec. 2.11.6) minus the column loss (Sec. 2.12) and discharge head loss. This is the head generally called for in pump specifications.

2.11.5.1. *On open-suction installations,* it is the algebraic sum of the head below datum and the head above datum.

2.11.5.2. *On closed-suction installations,* it is the algebraic sum of the suction head, the distance between the suction case flange and the datum, and the head above datum.

2.11.6. *Bowl assembly head* (h_t) is the energy imparted to the liquid by the pump (expressed in foot-pounds per pound of liquid). It is the head of a pump installed with a minimum length of column and shaft, as in the manufacturer's laboratory.

2.11.6.1. *On open-suction installations,* it is the algebraic sum of the head below datum and the head above datum.

2.11.6.2. *On closed-suction installations,* it is the algebraic sum of the suction head, the distance between the suction case flange and the datum, and the head above datum.

2.12. *The column loss* (h_c) is the value of the head loss (expressed in feet) due to the flow friction in the column pipe. This value is subtracted from the bowl assembly head to predict the pump total head.

2.13. *The line shaft loss* (hp_l) is the power (expressed in horsepower) required because of the rotation friction of the line shaft. This value is added to the bowl assembly input (Sec. 2.14.3) to predict the pump input (Sec. 2.14.1).

2.14. *Power* is expressed in units of horsepower. One horsepower is equivalent to 550 ft-lb per second, 33,000 ft-lb per minute, 2,545 Btu per hour, or 0.746 kw.

2.14.1. *Pump input* is the power delivered to the line shaft, expressed in horsepower.

2.14.2. *Driver power input* is the power input to the driver, expressed in horsepower.

2.14.3. *Bowl assembly input* is the power delivered to the pump shaft, expressed in horsepower. It is the pump input of a pump installed with a minimum of column and shaft, as in the manufacturer's laboratory.

2.15. *Output* is defined as follows:

2.15.1. *Pump output* is defined as $\frac{QH}{3{,}960}$ for water having a specific weight of 62.4 lb per cubic foot. It is expressed in horsepower.

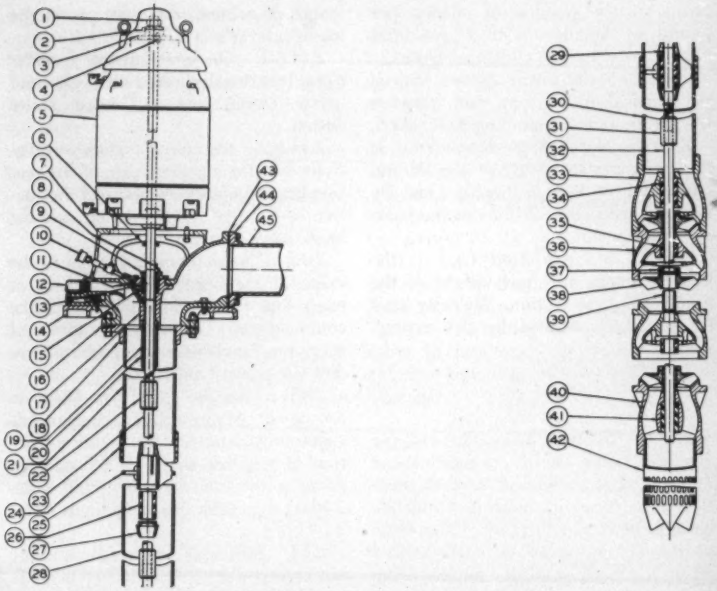

Fig. 3.1a. Open Line Shaft Pump (Surface Discharge, Threaded Column and Bowls)

2.15.2. *Bowl output* is defined as $\frac{Qh_t}{3{,}960}$ for water having a specific weight of 62.4 lb per cubic foot. It is expressed in horsepower.

2.16. *Efficiency* is defined as follows:

2.16.1. *Pump efficiency* (η_p) is the ratio of pump output to pump input, expressed in per cent.

2.16.2. *Overall efficiency* (η) is the ratio of pump output to driver power input, expressed in per cent.

2.16.3. *Driver efficiency* (η_d) is the ratio of the driver output to the driver input, expressed in per cent.

2.16.4. *Bowl assembly efficiency* (η_l), is the ratio of the bowl output to the bowl assembly input, expressed in per cent.

2.17. Additional definitions of terms generally applicable to the pumping of fluids other than water may be found in the American Society of Mechanical Engrs. "Power Test Code for Centrifugal and Rotary Pumps" and may be used when appropriate.

Section 3—Nomenclature

Sec. 3.1—Standard Nomenclature

Table 3.1 lists the name of the part, together with its function and typical material. The material listed is intended to be typical only and does not constitute a recommendation. The

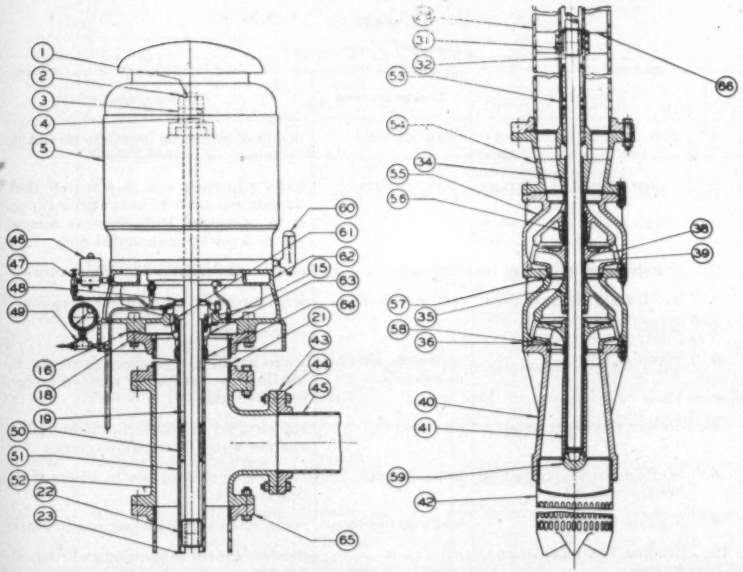

Fig. 3.1b. Enclosed Line Shaft Pump (Underground Discharge, Flanged Column and Bowls)

part number refers to the numbers in Fig. 3.1.

Sec. 3.2—Order Form

A recommended specification form for use in purchasing deep well turbine pumps is given in Table 3.2.

Section 4—General Specifications

Sec. 4.1—General

4.1.1. *Descriptive matter.* The bidder shall submit, with his proposal, sufficient descriptive material or outline drawings to demonstrate compliance with these specifications, and a performance curve showing pump total head, pump input horsepower, and pump efficiency over the specified head range for the installed pump.

4.1.2. *Sanitary codes.* The pump shall conform to the sanitary codes governing the installation. The purchaser shall furnish, as a part of these specifications, all information necessary for the construction of the pump to meet these requirements.

4.1.3. *Pump base.* A suitable base of cast iron or fabricated steel shall be provided for mounting the driver and supporting the pump column. The (aboveground or below ground) discharge outlet shall be flanged, or a nipple with a companion flange shall be

TABLE 3.1

Standard Nomenclature

Part No.	Name of Part	Typical Material	Function of Part
1	Top shaft adjusting nut	brass or steel	means of adjusting impellers vertically by raising or lowering shaft
2	Adjusting-nut lock screw	steel or brass	locks adjusting nut in place so that adjustment cannot change while pump is in operation (furnished as simple pin or screwed or threaded pin)
3	Top drive coupling	semisteel	couples top shaft with motor rotor
4	Key for top drive coupling	cold-rolled steel	keys top shaft to top drive coupling
5	Motor		drives pump
6	Water slinger	neoprene, rubber, or steel	keeps packing box leakage from shooting directly into hollow shaft of motor or driver unit
7	Surface discharge head	cast iron	supports driver and pump column; discharges water from pump column
8	Stuffing box stud bolts and hexagonal nuts	brass or steel	fastened in stuffing box to adjust stuffing box gland
9	Stuffing box gland	cast iron or bronze	compresses and holds packing in place
10	Stuffing box lubrication fittings		conduct grease to packing and journal bearing
11	Stuffing box gasket		placed under seat of packing containers to prevent leakage
12	Prelubrication fittings		conduct water to keep water-lubricated bearings wet during starting cycle
13	Top shaft sleeve	Monel or stainless steel	sleeve operating within packed area in top shaft on open line shaft pumps
14	Head base plate	cast iron or steel	plate or casting that supports discharge head and may become permanent part of foundation after initial installation
15	Packing		flexible material which can be compressed by stuffing box gland in stuffing box so as to prevent leakage of fluid being pumped
16	Top column flange gasket		seals joint between flange faces
17	Stuffing box	cast iron	guides shaft and holds packing
18	Top column flange	cast iron	couples column to discharge head

TABLE 3.1—*Standard Nomenclature* (*contd.*)

Part No.	Name of Part	Typical Material	Function of Part
19	Top shaft	steel	coupled to line shaft; connects latter to driver
20	Stilling tube	steel	suspended around top shaft from packing box to reduce flow of abrasive material into packing box
21	Top column pipe	steel	first section of column pipe below discharge
22	Line shaft coupling	steel	used to join all sections of line shafting throughout unit
23	Line shaft	steel	Those sections of line shafting between top shaft and pump shaft
24	Column pipe coupling	steel	couples sections of column pipe
25	Open line shaft bearing retainer	bronze	used to support line shaft bearing; generally located at end of each section of column pipe
26	Open line shaft bearing	rubber	bearing held in bearing retainer to guide line shafting of pump
27	Open line shaft bearing retainer cap	bronze	locks bearing within bearing retainer
28	Column pipe	steel	column pipe between top column and bottom column pipe; usually made of standard steel pipe
29	Open line shaft sleeve	Monel or stainless steel	sleeve operating as journal for bearings
30	Bottom column pipe	steel	first section of column immediately above discharge case or discharge bowl
31	Pump shaft coupling	steel	connects bottom shaft to impeller shaft; may be tapped with two different thread diameters
32	Pump shaft	stainless steel	supports impellers; coupled to line shaft
33	Discharge bowl	cast iron	receives flow from top impeller and guides it to pump column
34	Top bowl bearing	bronze or rubber	supports portion of pump shaft
35	Intermediate bowl bearing	bronze or rubber	supports portion of pump shaft
36	Intermediate bowl	cast iron	guides flow received from impeller to next impeller above
37	Impeller collet lock nut	bronze	used to pull impeller on collet; locks collet in place

TABLE 3.1—*Standard Nomenclature (contd.)*

Part No.	Name of Part	Typical Material	Function of Part
38	Impeller	bronze or cast iron	pumping element; receives water and impels it centrifugally to bowl passage
39	Impeller lock collet	steel	locks impeller to shaft
40	Suction bowl	cast iron	receives water from well; guides to first impeller
41	Suction bowl bearing	bronze	supports bottom portion of pump shaft
42	Strainer	galvanized steel or bronze	keeps large foreign material out of pumps
43	Discharge companion flange gasket	rubberized cloth or rubber	seals joints between surface discharge head or underground elbow and companion flange
44	Discharge companion flange	cast iron	connects discharge pipe to integrally cast flanges on discharge head or underground discharge elbow
45	Discharge pipe	steel	conducts water away from pump.
46	Solenoid oil valve		starts oil flow to line shaft bearings when motor is started
47	Sight-feed oil valve		means of adjusting oil flow to line shaft bearings
48	Tubing tension nut cap	cast iron	covers top of oil tube to prevent entrance of dust
49	Water level indicator assembly		determines water level in well
50	Enclosed line shaft bearing	bronze	guides and supports shaft section; may couple connecting sections of enclosing tube
51	Shaft enclosing tube	steel	encloses line shaft
52	Underground discharge tee	cast iron	changes flow from vertical to horizontal when discharge is below surface; also forms part of column
53	Tubing adapter	cast iron or steel	encloses shaft; adapts standard tube size to off-standard tube size
54	Discharge case	cast iron	guides flow to pump column
55	Top bowl	cast iron	receives flow from top impeller and guides it to discharge case
56	Bypass seal		restricts leakage from bowls to oil tube; seals off bowl passages from enclosing tube

TABLE 3.1—*Standard Nomenclature* (*contd.*)

Part No.	Name of Part	Typical Material	Function of Part
57	Impeller seal ring	rubber, bronze, or hardened steel	provides water seal at impeller
58	Suction case sand collar	bronze	prevents sand from entering suction case bearing
59	Suction case plug	black iron	plugs suction case grease container
60	Oil gage assembly for motor bearings		shows level of oil in motor oil reservoir
61	Packing follower	cast iron	tightens packing around enclosing tube
62	Underground discharge head	cast iron	supports motor above foundation when discharge is below surface
63	Tubing tension nut	semisteel	maintains tension on shaft enclosing tube
64	Lock nut for tubing tension nut	cast brass	locks tubing nut
65	Column flange	steel	joins sections of column pipe
66	Enclosing tube stabilizer	bronze or rubber	stabilizes shaft enclosing tube

furnished for a 125-lb ASA standard connection, as specified.

4.1.4. *Driver.* With electric power, the motor shall be of the full-voltage starting, vertical hollow-shaft squirrel-cage induction type, and shall comply with ASA Specification C70. The connection to the pump shaft shall be through a coupling or clutch in the motor head. The motor shall be of the proper size to drive the pump continuously over the specified operating range without the load exceeding the service factor. The motor shall be rated as dripproof 40°C rise design with 1.15 service factor. (Standard motor voltages are 208, 220, 440, 550, 2,300.)

With a gasoline or diesel engine drive, the power shall be applied to the pump shaft through a right-angle gear set. The connection to the vertical shaft shall be through a coupling or clutch in the gear head. The horizontal shaft shall rotate in the same direction as the engine drive, and shall be connected to the engine by a flexible shaft type coupling.

An optional method of driving, for an engine or horizontal electric motor, shall be a belt head—either a flat belt on a modified cylindrical pulley, or a V-belt on a V-groove pulley.

Rotation of the vertical shaft shall be counterclockwise when viewed from above.

A thrust bearing of ample capacity to carry the weight of all rotating parts plus the hydraulic thrust shall be incorporated into the driver as an integral part of it. The bearing shall be of such a size that the average life rating is no less than 5 years' continuous operation.

TABLE 3.2

Suggested Specification Form for the Purchase of ASA Deep Well Vertical Turbine Pumps

1. Purchaser.....
2. Address .....
3. Installation site.....
4. Job No. ..... Item No. ..... Quote No.....
   P.O. No.....
5. No. required..... By ..... Date.....
6. Driver: Electric motor ..... Right-angle gear..... Belt.....
   Engine .....

Pump Operating Conditions

7. Capacity ..... gpm; Maximum speed ..... rpm
   Elevation at site ..... ft
8. Pumping level below ground level at rated capacity ..... ft
9. Pumping head above ground level, including discharge pipe friction ..... ft
10. Rated total pump head (Lines 8 plus 9, above) ..... ft
11. Operating range: Minimum total head ..... ft
    Maximum total head ..... ft
12. Pump setting ..... ft

Description of Well

13. Minimum inside diameter of well or casing ..... in., to a depth of ..... ft
14. Total depth of well ..... ft
15. Well straight to a depth of ..... ft (a well is considered straight if a 20-ft long cylinder equal to a bowl diameter will not bind when lowered to a depth equal to the pump setting)
16. Static water level below ground surface ..... ft
17. Pumping drawdown ..... ft at ..... gpm
18. Well developed to ..... per cent of rated pump capacity
19. Sand in water: None ..... Average ..... High ..... Unknown .....
20. Gas in water: None ..... Average ..... High ..... Unknown .....
21. Water corrosive: Yes ..... No .....
22. Corrosive substances .....
    Materials to resist corrosion .....

Driver Data

23. Electric power available .....: Maximum horsepower .....
    Volts..... Cycles ..... Phase.....
24. Other driver available .....: Maximum horsepower .....
    (Gas) (Gasoline) (Diesel) engine; Drive: (Direct) (Belt)
25. V-belt size .....: Groove type sheave ..... diameter
    Flat belt ..... width; Pulley diameter .....

Connections and Accessories

26. Discharge flange ..... in., 125-lb ASA Standard threaded companion flange above-ground standard (if underground discharge desired, centerline shall be ..... ft below ground level)
27. Strainer required: Yes ..... No .....
28. Solenoid oiler required: Yes ..... No ..... Voltage available .....
29. Prelube water tank required: Yes ..... No .....
30 Automatic controls required: Time delay relay ..... Float switch .....

Pumps are to be furnished in accordance with ASA Specification B58, with the following exceptions:

4.1.5. *Suction pipe and strainer.* A strainer, if required, shall have a net inlet area equal to at least two times the suction pipe area. The maximum opening shall be not more than 75 per cent of the minimum opening of the water passage through the bowl or impeller.

Sec. 4.2—Oil-lubricated Pump and Column

4.2.1. *Pump bowls.* The castings shall be free of blow holes, sand holes, and other detrimental defects. The bowls shall be capable of withstanding a hydrostatic pressure equal to twice the pressure at rated capacity or 1½ times shutoff head, whichever is greater. Bowls may be equipped with replaceable seal rings on the suction side of enclosed impellers. The discharge case shall be provided with a means of reducing to a minimum the leakage of water into the shaft enclosing tube, and must have bypass ports of sufficient area to permit the escape of water that leaks through the seal or bushing.

4.2.2. *Impellers.* The impellers shall be of the enclosed or semiopen type, statically balanced. They shall be securely fastened to the impeller shaft with keys, taper bushings, or lock nuts. They shall be adjustable vertically by means of a nut in the motor head.

4.2.3. *Pump shaft.* The pump shaft shall be turned and ground, and it shall be supported by bearings above and below each impeller. The size of the shaft shall be determined by the calculation procedures and stress values outlined in ASA B17c, "Code for Design of Transmission Shafting."

The maximum intensity of shear of the shaft material shall be calculated by formula from ASA B17c.

For this specific application with steady loads of diffuser type pumps with shaft in tension due to hydraulic thrust ($\alpha = 1$; $K_t = 1$; $M = 0$; $K = 1$):

$$D^3 = \frac{16}{\pi P_t}\sqrt{\left(\frac{FD}{8}\right)^2 + \left(\frac{396{,}000P}{2\pi N}\right)^2}$$

or:

$$P_t = \sqrt{\left(\frac{2F}{\pi D^2}\right)^2 + \left(\frac{321{,}000P}{ND^3}\right)^2}$$

in which D is diameter (in inches) of shaft at root of threads or any similar undercut; F is axial thrust on shaft, in pounds; N is number of revolutions per minute; P is horsepower; and P_t is combined shear stress, in pounds per square inch.

The maximum combined shear stress (P_t) shall not exceed 30 per cent of the elastic limit in tension or be more than 18 per cent of the ultimate tensile strength of the shafting steel used.

The straightness and machining tolerances shall be the same as those given under "Line Shafts" (Sec. 4.2.4).

4.2.4. *Line shafts.* The line shafts shall be ground, of carbon steel, and of the size that will conform to the ratings in Table 5.5. The shaft shall be furnished in interchangeable sections having a nominal length of 10 ft. To insure accurate alignment of the shafts, they shall be straight within 0.005-in. total indicator reading for a 10-ft section; the butting faces shall be machined square to the axis of the shaft; the maximum permissible error in the axial alignment of the thread axis with the axis of the shaft shall be 0.002 in. in 6 in. The line shaft shall be coupled with steel couplings, which shall be designed with a safety factor of 1½ times the shaft safety factor and shall have a left-hand thread to tighten during pump operation.

4.2.5. *Line shaft bearings.* The line shaft bearings, which also have integral couplings, shall be spaced not more than 5 ft apart. The maximum angle error of the thread axis to the bore axis shall be within 0.001 in. per inch of thread length. The concentricity of the bore to the threads shall be within 0.005-in. total indicator reading. The bearings must contain oil grooves or a separate bypass hole which will readily allow the oil to flow through and lubricate the bearings below.

4.2.6. *Shaft-enclosing tube.* The shaft-enclosing tube shall be made of extra-strong steel pipe in interchangeable sections not more than 5 ft in length. Each section shall be machined and threaded relative to accurately prepared diameters at extreme ends of the tube or by means of locating devices mounted thereon. The ends of the enclosing tube shall be square with the axis and shall butt to insure accurate alignment. The maximum angle error of the thread axis relative to the bore axis shall be 0.001 in. per inch of thread length. The enclosing tube shall be stabilized in the column pipe by stabilizers.

4.2.7. *Discharge column pipe.* The pipe size shall be such that the friction loss will not exceed 5 ft per 100 ft, based on the rated capacity of the pump. The pipe shall be furnished in interchangeable sections having a nominal length of 10 ft; shall be of standard weight, conforming to the specifications in Table 5.1; and shall be connected by threaded sleeve type couplings. The ends of each section of pipe may be faced parallel and machined with threads to permit ends to butt, or they may be fixed with ASA standard tapered pipe threads.

4.2.8. *Discharge head assembly.* At the surface discharge head or underground discharge head, a proper lubrication system must be installed; it shall consist of a manually operated sight-feed drip lubricator and an oil reservoir of ample capacity, constructed as an integral part of the head or as a separate auxiliary unit. A tubing tension nut shall be installed in the head to allow tension to be placed on the shaft enclosing tube. Provision must be made for sealing off the threads at the tension nut.

Sec. 4.3—Water-lubricated Pump and Column

4.3.1. *Pump bowls.* The castings shall be free of blow holes, sand holes, and other detrimental defects. The bowls shall be capable of withstanding a hydrostatic pressure equal to twice the pressure at rated capacity or 1½ times shutoff head, whichever is greater. Bowls may be equipped with replaceable seal rings on the suction side of enclosed impellers.

4.3.2. *Impellers.* The impellers shall be of the enclosed or semiopen type, statically balanced. They shall be securely fastened to the impeller shaft with keys, taper bushings, or lock nuts. They shall be adjustable vertically by means of a nut in the motor head.

4.3.3. *Pump shaft.* The pump shaft shall be turned and ground, and it shall be supported by bearings above and below each impeller. The size of the shaft shall be determined by the calculation procedures and stress values outlined in ASA B17c, "Code for Design of Transmission Shafting."

The maximum intensity of shear of the shaft material shall be calculated by formula from ASA B17c.

For this specific application with steady loads of diffuser type pumps with shaft in tension due to hydraulic thrust ($\alpha = 1$; $K_t = 1$; $M = 0$; $K = 1$):

$$D^3 = \frac{16}{\pi P_t}\sqrt{\left(\frac{FD}{8}\right)^2 + \left(\frac{396{,}000P}{2\pi N}\right)^2}$$

or:

$$P_t = \sqrt{\left(\frac{2F}{\pi D^2}\right)^2 + \left(\frac{321{,}000P}{ND^3}\right)^2}$$

in which D is diameter (in inches) of shaft at root of threads or any similar undercut; F is axial thrust on shaft, in pounds; N is number of revolutions per minute; P is horsepower; and P_t is combined shear stress, in pounds per square inch.

The maximum combined shear stress (P_t) shall not exceed 30 per cent of the elastic limit in tension or be more than 18 per cent of the ultimate tensile strength of the shafting steel used.

The straightness and machining tolerances shall be the same as given under "Line Shafts" (Sec. 4.3.4).

4.3.4. *Line shafts.* The line shafts shall be ground, of carbon steel, and of the size that will conform to the ratings in Table 5.5. The shaft shall be furnished in interchangeable sections having a nominal length of 10 ft. To insure accurate alignment of the shafts, they shall be straight within 0.005-in. total indicator reading for a 10-ft section; the butting faces shall be machined square to the axis of the shaft; the maximum permissible error in the axial alignment of the thread axis with the axis of the shaft shall be 0.002 in. in 6 in. The line shaft shall be coupled with steel couplings, which shall be designed with a safety factor of 1½ times the shaft safety factor and shall have a left-hand thread to tighten during pump operation. The shaft shall be provided with a noncorrosive wearing surface at the location of each guide bearing.

4.3.5. *Line shaft bearings.* The shaft bearings shall be designed for vertical turbine pump service, to be lubricated by the liquid pumped. They shall be mounted in bearing retainers which shall be held in position in the column couplings by means of the butted ends of the column pipes. The bearings shall be spaced at intervals of not more than 10 ft.

4.3.6. *Discharge column pipe.* The pipe size shall be such that the friction loss will not exceed 5 ft per 100 ft, based on the rated capacity of the pump. The pipe shall be furnished in interchangeable sections having a nominal length of 10 ft; shall be of standard weight, conforming to the specifications in Table 5.1; and shall be connected with threaded sleeve type couplings. The ends of each section of column pipe shall be faced parallel and the threads machined to such a degree that the ends will butt, to insure proper alignment when assembled.

4.3.7. *Discharge head assembly.* The pump shall be provided with a discharge head of the surface or underground type, as required, and shall be provided with a shaft packing box and a renewable bronze bushing. The head shall also include a prelubrication connection to wet down the line shaft bearings adequately before starting the pump.

4.3.8. *Prelubrication.* Provisions shall be made by the manufacturer to prelubricate line shaft bearings adequately before the pump is started, on installations with a setting of more than 50 ft.

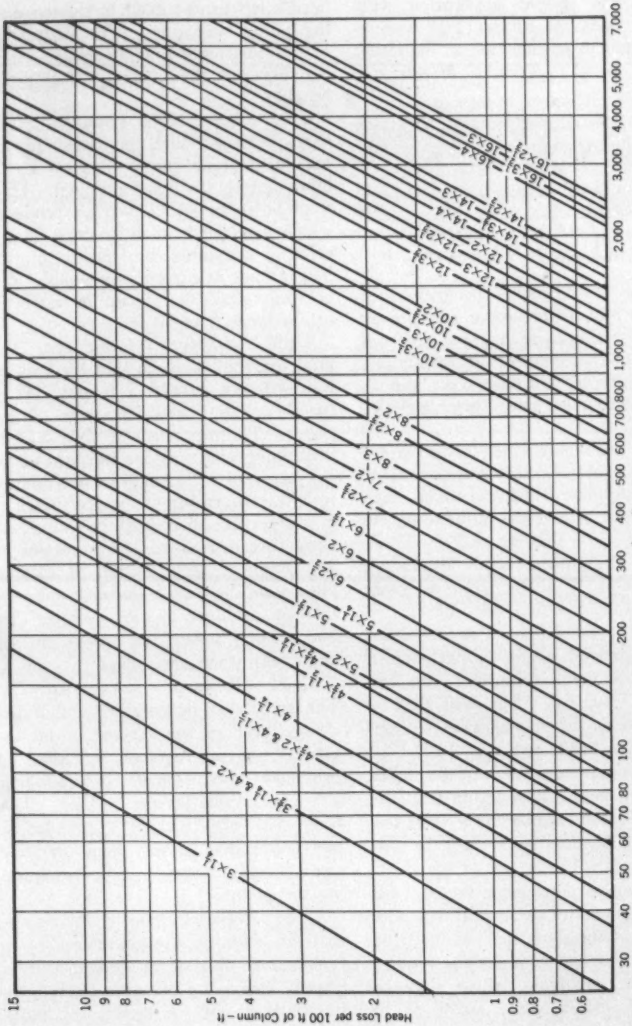

Fig. 5.2. Friction Loss Chart for Standard Pipe Column (See Note on Facing Page)

Where manual control is used and a source of fresh water under pressure is not available, a prelubricating tank, with the necessary valves and fittings to connect it to the pump, shall be provided. The size of the tank shall be adequate to permit thorough wetting of all the line shaft bearings before the power is applied, with an adequate reserve for repeating the process in the event that the pump does not start the first time for any reason.

If an automatic system is used, bypass fittings or other suitable means shall be provided to bring the prelubricating water from ahead of the check valve into the prelubricating opening of the discharge head. This normally implies the use of a time delay relay in the starting system and a solenoid valve in the prelubricating line.

4.3.9. *Ratchets.* Water-lubricated deep well turbine pumps having a setting of 50 ft or more shall be provided with a nonreverse mechanism in the motor to protect the line shaft bearings from reverse rotation when the power is interrupted and the water empties from the discharge column.

Section 5—Engineering Data

Sec. 5.1—Discharge Column Pipe

Diameters and weights of standard discharge column pipe sizes are given in Table 5.1.

Sec. 5.2—Column Friction Loss

The column friction chart (Fig. 5.2) should be used to determine the loss in head due to column friction. This chart has been compiled from data on head losses where the flow is between the inside diameter of the column pipe and the outside diameter of the shaft-enclosing tube.

For open line shafting, the losses shown on Fig. 5.2 should be used by assuming the losses equal to those indicated on the chart for a shaft-enclosing tube of a size that would normally enclose the open line shaft in question.

Explanation of Fig. 5.2.

Diagonals are labeled to show nominal diameters (in inches) of outer pipe column and inner shaft enclosing tube. For the outer pipe columns, the calculations used in constructing the chart were based on inside diameters, which are close to the nominal sizes for pipe up to and including 12 in. (for example, 10 in. = 10.2-in. ID); in sizes 14 in. and larger, the diameters shown are equivalent to the outside diameter of pipe ⅜-in. wall thickness (for example, 16 in. = 15¼-in. ID). For the inner columns (shaft enclosing tubes), the calculations were based on the outside diameters of standard or extra-heavy pipe. Thus, "8 × 2" on the chart is actually 8.071 × 2⅜, and "16 × 3" is 15¼ × 3½. (Chart reprinted by permission of Hydraulic Institute, Inc.)

Sec. 5.3—Discharge Head Loss

The discharge head loss chart (Fig. 5.3) should be used to determine the

TABLE 5.1

Standard Specifications for Discharge Column Pipe

Nominal Size (ID) *in.*	OD *in.*	Weight per Foot (Plain Ends) *lb*
2½	2.875	5.79
3	3.500	7.58
3½	4.000	9.11
4	4.500	10.79
4½	5.000	12.54
5	5.563	14.62
6	6.625	18.97
7	7.625	22.26
8	8.625	24.70
9	9.625	28.33
10	10.750	31.20
12	12.750	43.77
14*	14.000	54.57
16*	16.000	62.58

* OD.

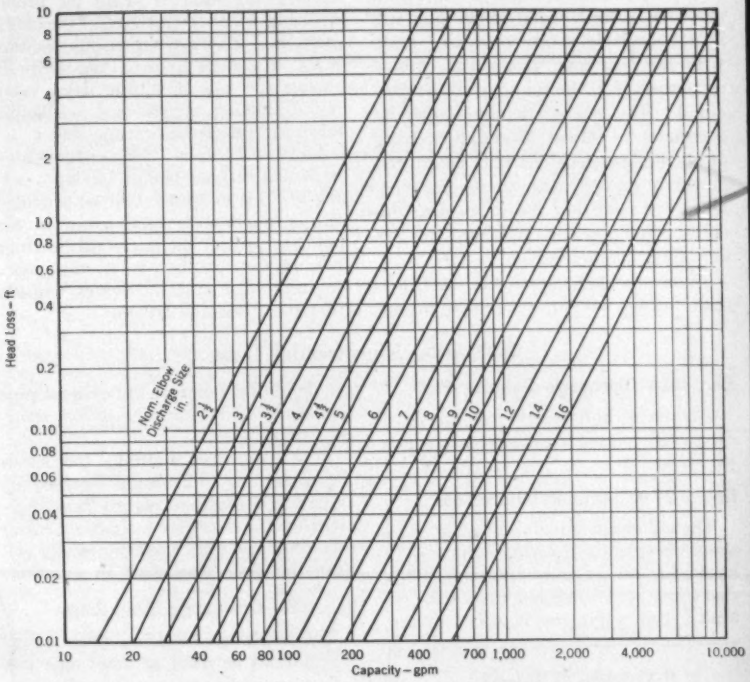

Fig. 5.3. Head Loss in Discharge Heads

hydraulic losses in the discharge head. Losses in discharge heads vary with the size of the head, the design of the head, and the size of tubing or shaft, column, and discharge pipe used. Figure 5.3 represents estimated average losses. Where extreme accuracy is imperative, actual loss measurements in the discharge head to be used—with the correct tubing or shaft, column, and discharge pipe—should be specified on the bid request by the purchaser.

Sec. 5.4—Mechanical Friction

The mechanical-friction chart (Fig. 5.4) should be used to determine the added horsepower due to mechanical friction in rotating the line shaft. The chart was compiled from test data submitted by representative turbine pump manufacturers. Variations in designs

Explanation of Fig. 5.4

The chart shows values for enclosed shaft with oil or water lubrication and drip feed, or for open shaft with water lubrication. For enclosed shaft with flooded tube, read two times the value of friction shown on the chart. (Chart reprinted by permission of Hydraulic Institute, Inc.)

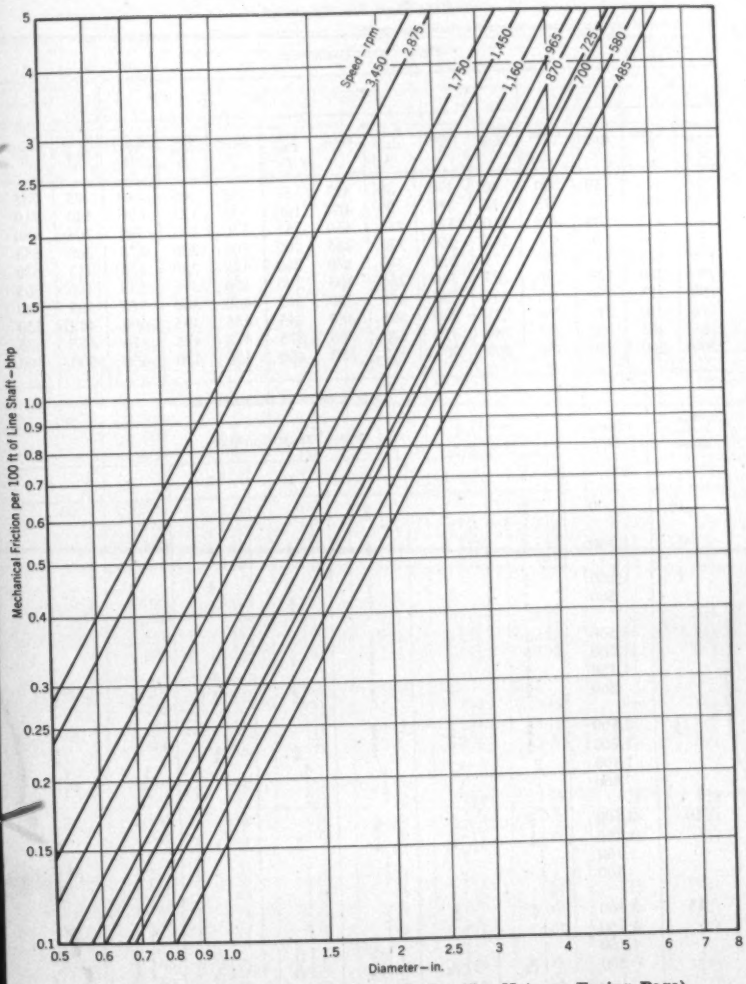

Fig. 5.4. Mechanical Friction in Line Shafts (See Note on Facing Page)

TABLE 5.5

*Line Shaft Size Selection**

Pump Thrust Conditions†

A		B		C		D		E		F		G	
Setting *ft*	Head *ft*	Setting *ft*	Head *ft*	Setting *ft*	Head *ft*	Setting *ft*	Head *ft*	Setting *ft*	Head *ft*	Setting *ft*	Head *ft*	Setting *ft*	Head *ft*
25	245	30	320	40	390	50	475	55	555	65	640	75	735
50	240	65	315	75	380	90	460	110	535	125	620	140	710
70	235	90	305	110	370	135	450	155	520	175	595	205	680
90	230	120	300	145	360	175	435	200	500	230	575	260	655
110	225	145	290	175	350	210	420	240	485	280	555	315	630
130	220	170	280	205	340	245	405	280	470	320	535	360	605
150	215	190	275	230	330	275	390	315	450	360	515	405	580
170	210	215	265	255	320	305	380	345	435	395	490	440	550
185	205	230	260	280	310	330	365	375	415	425	470	475	525
200	200	250	250	300	300	350	350	400	400	450	450	500	500

Max. Horsepower	Speed *rpm*	Min. Line Shaft Diameter—*in.* Pump Thrust Condition						
		A	B	C	D	E	F	G
1½	3,500	¾	¾	¾				
2	1,760	¾	¾	¾	¾	¾	¾	¾
3	1,160	¾	¾	¾	¾	¾	¾	¾
	860	¾	¾	¾	¾	¾	¾	¾
5	3,500	¾	¾	¾				
	1,760	¾	¾	¾	¾	¾	¾	¾
	1,160	¾	¾	¾	¾	¾	¾	¾
	860	¾	¾	¾	¾	¾	¾	¾
7½	3,500	¾	¾	¾				
	1,760	¾	¾	¾	¾	¾	¾	¾
	1,160	1	1	1	1	1	1	1
	860	1	1	1	1	1	1	1
10	3,500	¾	¾	¾				
	1,760	¾	¾	¾	¾	¾	¾	¾
	1,160	1	1	1	1	1	1	1
	860	1	1	1	1	1	1	1
15	3,500	¾	¾	¾				
	1,760	1	1	1	1	1	1	1
	1,160	1	1	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16
	860	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16
20	3,500	¾	¾	¾				
	1,760	1	1	1	1	1	1	1
	1,160	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16
	860	1 3/16	1 3/16	1 7/16	1 7/16	1 7/16	1 7/16	1 7/16

* For SAE 1020 carbon steel. † Maximum total pumping head for settings shown.

TABLE 5.5—*Line Shaft Size Selection (contd.)**

Max. Horsepower	Speed *rpm*	Min. Line Shaft Diameter—*in.*						
		Pump Thrust Condition						
		A	B	C	D	E	F	G
25	3,500	1	1	1				
	1,760	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16
	1,160	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16
	860	1 7/16	1 7/16	1 7/16	1 7/16	1 7/16	1 7/16	1 7/16
30	3,500	1	1	1				
	1,760	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16	1 3/16
	1,160	1 7/16	1 7/16	1 7/16	1 7/16	1 7/16	1 7/16	1 7/16
	860	1 7/16	1 7/16	1 7/16	1 7/16	1 7/16	1 7/16	1 7/16
40	3,500	1	1	1				
	1,760	1 3/16	1 3/16	1 3/16	1 7/16	1 7/16	1 7/16	1 7/16
	1,160	1 7/16	1 7/16	1 7/16	1 7/16	1 7/16	1 7/16	1 7/16
	860	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16
50	3,500	1 3/16	1 3/16	1 3/16				
	1,760	1 7/16	1 7/16	1 7/16	1 7/16	1 7/16	1 7/16	1 7/16
	1,160	1 7/16	1 7/16	1 7/16	1 7/16	1 11/16	1 11/16	1 11/16
	860	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16
60	3,500	1 3/16	1 3/16	1 3/16				
	1,760	1 7/16	1 7/16	1 7/16	1 7/16	1 7/16	1 7/16	1 7/16
	1,160	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16
	860	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16
75	3,500	1 3/16	1 3/16	1 3/16				
	1,760	1 7/16	1 7/16	1 7/16	1 7/16	1 11/16	1 11/16	1 11/16
	1,160	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16
	860	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16
100	3,500	1 7/16	1 7/16	1 7/16				
	1,760	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16
	1,160	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16
	860	2 3/16	2 3/16	2 3/16	2 3/16	2 3/16	2 3/16	2 3/16
125	3,500	1 7/16	1 7/16	1 7/16				
	1,760	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16
	1,160	1 11/16	1 11/16	2 3/16	2 3/16	2 3/16	2 3/16	2 3/16
	860	2 3/16	2 3/16	2 3/16	2 3/16	2 3/16	2 3/16	2 3/16
150	3,500	1 7/16	1 7/16	1 7/16				
	1,760	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16	1 11/16
	1,160	2 3/16	2 3/16	2 3/16	2 3/16	2 3/16	2 3/16	2 3/16
	860	2 3/16	2 7/16	2 7/16	2 7/16	2 7/16	2 7/16	2 7/16
200	1,760	2 3/16	2 3/16	2 3/16	2 3/16	2 3/16	2 3/16	2 3/16
	1,160	2 7/16	2 7/16	2 7/16	2 7/16	2 7/16	2 7/16	2 7/16
	860	2 7/16	2 7/16	2 7/16	2 7/16	2 7/16	2 7/16	2 7/16

* For SAE 1020 carbon steel.

TABLE 5.5—*Line Shaft Size Selection (contd.)**

Max. Horsepower	Speed *rpm*	Min. Line Shaft Diameter—*in.*						
		Pump Thrust Condition						
		A	B	C	D	E	F	G
250	1,760	2 3/16	2 3/16	2 3/16	2 3/16	2 3/16	2 3/16	2 3/16
	1,160	2 7/16	2 7/16	2 7/16	2 7/16	2 7/16	2 7/16	2 7/16
	860	2 11/16	2 11/16	2 11/16	2 11/16	2 11/16	2 11/16	2 11/16
300	1,760	2 7/16	2 7/16	2 7/16	2 7/16	2 7/16	2 7/16	2 7/16
	1,160	2 11/16	2 11/16	2 11/16	2 11/16	2 11/16	2 11/16	2 11/16
	860	2 15/16	2 15/16	2 15/16	2 15/16	2 15/16	2 15/16	2 15/16
350	1,760	2 7/16	2 7/16	2 7/16	2 7/16	2 7/16	2 7/16	2 7/16
	1,160	2 11/16	2 11/16	2 11/16	2 11/16	2 11/16	2 11/16	2 11/16
	860	2 15/16	2 15/16	2 15/16	2 15/16	2 15/16	2 15/16	2 15/16
400	1,760	2 7/16	2 7/16	2 7/16	2 7/16	2 7/16	2 7/16	2 7/16
	1,160	2 11/16	2 15/16	2 15/16	2 15/16	2 15/16	2 15/16	2 15/16
	860	3 3/16	3 3/16	3 3/16	3 3/16	3 3/16	3 3/16	3 3/16
450	1,760	2 11/16	2 11/16	2 11/16	2 11/16	2 11/16	2 11/16	2 11/16
	1,160	2 15/16	2 15/16	2 15/16	2 15/16	2 15/16	2 15/16	2 15/16
	860	3 3/16	3 3/16	3 3/16	3 3/16	3 3/16	3 3/16	3 3/16
500	1,760	2 11/16	2 11/16	2 11/16	2 11/16	2 11/16	2 11/16	2 11/16
	1,160	2 15/16	2 15/16	2 15/16	2 15/16	2 15/16	2 15/16	2 15/16
	860	3 3/16	3 3/16	3 3/16	3 3/16	3 7/16	3 7/16	3 7/16
600	1,760	2 11/16	2 11/16	2 15/16	2 15/16	2 15/16	2 15/16	2 15/16
	1,160	3 3/16	3 3/16	3 3/16	3 3/16	3 3/16	3 3/16	3 3/16
	860	3 7/16	3 7/16	3 7/16	3 7/16	3 7/16	2 15/16	2 15/16
700	1,760	2 15/16	2 15/16	2 15/16	2 15/16	2 15/16	3 7/16	3 7/16
	1,160	3 3/16	3 7/16	3 7/16	3 7/16	3 7/16		
800	1,760	2 15/16	2 15/16	3 3/16	3 3/16	3 3/16	3 3/16	3 3/16
	1,160	3 7/16	3 7/16	3 7/16	3 7/16	3 7/16		
900	1,760	3 3/16	3 3/16	3 3/16	3 3/16	3 3/16	3 3/16	3 3/16
1,000	1,760	3 3/16	3 3/16	3 3/16	3 7/16	3 7/16	3 7/16	3 7/16

* For SAE 1020 carbon steel.

used by individual manufacturers may affect the figures slightly.

Sec. 5.5—Line Shaft Selection

Line shaft selection should be made in accordance with the following procedure, using Table 5.5.

5.5.1. Table 5.5 does not limit the maximum rotative speed of shafts, the maximum setting of shafts, or the bearing spacing used with the shafting.

5.5.2. Table 5.5 defines the maximum recommended horsepower for a given size of shaft, taking into account the setting of the pump, the effect of the hydraulic thrust of the pumping equipment, and the weight of the line shafting. The ratings listed are based

on the use of SAE 1020 cold-finished steel. The maximum stresses used comply with those listed.

5.5.3. When an electric-motor driver is used, the horsepower applied to the shaft may exceed that listed by 15 per cent.

5.5.4. For conditions not indicated in Table 5.5, or for any material other than SAE 1020 steel, the shaft size shall be calculated in the manner described in Sec. 4.2.3 or 4.3.3 ("Pump Shaft"). A maximum of 7,000-psi combined shear stress (P_t) shall be used for line shaft calculations when SAE 1020 steel is used.

Section 6—Factory Inspection and Tests

Sec. 6.1—Performance Tests

6.1.1. The standard procedure for determining the performance of a vertical turbine pump by making a factory laboratory test of the bowl assembly and then calculating the anticipated field performance is described below. A performance test will be made only when specified in the purchaser's inquiry and order. The inquiry and order shall specify which of the following are required:

a. Standard running test
b. Witnessed running test
c. Shop inspection
d. Hydrostatic test of discharge head
e. Hydrostatic test of bowl assembly

If other tests are required, the purchaser shall describe them in detail.

6.1.2. The manufacturer shall notify the purchaser not less than 10 days prior to the date the pump or pumps will be ready for inspection or witness test.

Sec. 6.2—Standard Running Test

6.2.1. The pump bowl assembly will be operated from zero capacity to the maximum capacity shown on the performance curve submitted with the manufacturer's bid. Readings shall be taken at a minimum of five capacity points, including one point within ± 2 per cent of the design capacity specified on the request for bid.

The pump shall be operated at a speed within ± 5 per cent of the design speed. This does not apply to model or slow-speed tests described in Sec. 6.9.

6.2.2. At the conclusion of the test, three copies of the test data sheet and the anticipated field performance curve shall be supplied to the purchaser.

Sec. 6.3—Typical Laboratory Test Arrangement

Figure 6.3 indicates a typical laboratory arrangement for the testing of a vertical turbine pump. A test laboratory will normally be constructed to provide favorable suction conditions for pump performance. If the purchaser plans to use the pump under questionable well or sump conditions and wishes the pump to be tested under these exact conditions, complete information should be included in the request for bid. If there is nothing stated in the bid with relation to required well or sump conditions, it is assumed that standard laboratory arrangements will be used.

Sec. 6.4—Capacity Measurement

The capacity of the pump shall be measured by means of a standard venturi tube, nozzle, orifice plate, or pitot tube traverse. The pump manufacturer shall supply evidence that the capacity-measuring device used has been properly calibrated, that it is in good condition, and that the pressure taps and piping are proper for the instrument being used and are essentially

the same as during the calibration. Instruments which have not been calibrated should be geometrically similar to properly calibrated models.

A description of the application of fluid meters is contained in the ASME publication, "Fluid Meters—Their Theory and Application." A detailed description of the various meters and their application is given in Chapter B-2 of that publication, the physical constants and meter coefficients are indicated in Section C, and the discharge coefficient tolerances of the various meters are indicated in Chapter C-7.

The surface conditions, size, and length of the pipe preceding the fluid-measuring device are as important as the calibration of the device itself. Thus, piping should be in close conformity with that used when the instrument was calibrated or in accordance with the recommendations by the manufacturer of the fluid-measuring device.

Fluid manometers should be used for measuring the pressure differential across the meter.

Sec. 6.5—Head Measurement

All pump bowl assembly tests shall be made in open sumps, unless otherwise stated in the request for bid.

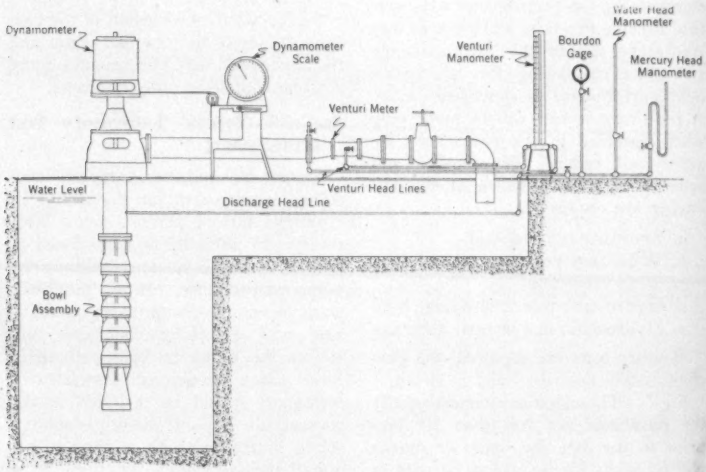

Fig. 6.3. Typical Laboratory Test Arrangement

The pressure tap for head measurement shall be located in the discharge column not less than 2 ft above the pump bowl assembly. The pressure tap shall be at right angles to the pipe, free from burrs, and flush with the surface of the column pipe. The openings shall be of a diameter from $\frac{1}{8}$ to $\frac{1}{4}$ in. and of a length not less than twice the diameter.

As an alternate method, the pressure tap for head measurement can also be located not less than ten diameters downstream from the discharge elbow of the test pump. (The elbow to be furnished with the pump shall be used.) When the pump head is measured at this point, no deduction for elbow loss need be made in anticipating field performance.

For head measurements of 36 ft or less, only fluid manometers shall be used. For head measurements in excess of 36 ft, calibrated Bourdon or other gages with equivalent accuracy and reliability can be used. All gages shall be calibrated before and after each series of tests.

Sec. 6.6—Velocity Head

The average velocity in the pump column used to determine the velocity head shall be calculated from dimensions obtained by actual measurement of the pipe and shaft or enclosing-tube diameter at the point of pressure measurement.

If the pressure measurement is made downstream from the discharge elbow, the velocity head shall be obtained from actual measurement of the inside diameters of the discharge pipe at the point where the pressure tap is located.

Sec. 6.7—Horsepower Input to Pump

The power input to the pump shall be determined by means of a vertical dynamometer or a calibrated electric motor.

The torque of the dynamometer shall be measured by means of a calibrated springless scale, calibrated strain gage, or other device of equivalent accuracy.

Squirrel-cage induction motors (when operated at greater than half the nameplate rating), direct current motors, synchronous motors, or wound-rotor induction motors with short-circuited secondary resistance may be employed for the determination of shaft input, provided the efficiencies or losses have been ascertained by an AIEE test or its equivalent.

Where the specifications call for an overall efficiency guarantee, the actual job motor can be used without calibration and the overall bowl assembly efficiency calculated directly.

Calibrated laboratory type electric meters and transformers shall be used to measure the power input to all motors.

Sec. 6.8—Measurement of Speed

The rotating speed of the pump shall be obtained by a hand counter or a stroboscope counting slip. It should be noted that an accurate speed reading is important in determining power input when a dynamometer is used. Accuracy is less important when a calibrated motor is used.

Sec. 6.9—Large-Pump Tests

6.9.1. On all pump bowl assemblies where the horsepower is not in excess of 200 and the bowl diameter is not in excess of 20 in., the actual pump shall be tested in the manufacturer's laboratory.

6.9.2. If the horsepower exceeds 200, it shall be permissible for the manufacturer to test only the number of stages of the unit which come within this power requirement. If a test is made on a limited number of stages, no increase in efficiency shall be permitted for an increased number of stages when predicting the final performance of the complete bowl assembly. The head and horsepower shall be increased in direct proportion to the number of stages in the final assembly, compared

with the number of stages used in the laboratory test.

6.9.3. When the size of the bowls exceeds 20-in. OD, a laboratory test on a model pump, homologous with the actual unit, may be used as a basis for the determination of the performance of the actual unit. (In general, when contract guarantees are to be based on model tests, the contract should specify model performance rather than inferred actual-unit performance. In the absence of this provision, allowance for the scale effect, if any, shall be agreed upon in writing by the representatives of both parties prior to the tests.)

The model pump shall be run at a speed sufficient to develop a head per stage at least equal to that of the actual unit, so that the velocities will equal or exceed those of the actual unit; or the manufacturer must submit evidence that a single-stage model does not cavitate under specified field suction conditions when operated at a speed such that the velocities will equal or exceed those of the actual unit.

6.9.4. On bowl assemblies which have an OD exceeding 20 in. or which require more than 200 hp, it will be permissible to test the actual bowl assembly at a speed slower than that at which the pump will run in the field rather than make a model test. No efficiency increase will be allowed when the performance in the slow-speed test is translated into that at full speed. The manufacturer must submit evidence that a single-stage bowl assembly or a single-stage model does not cavitate under specified field suction conditions when operated at a speed such that the velocities will equal or exceed those of the actual unit.

6.9.5. All large bowl assembly full-speed tests or model tests must be conducted with the identical submergence that will exist in the field, as shown on the request for bids.

Sec. 6.10—Hydrostatic Tests

6.10.1. A standard hydrostatic test on the pump bowl assembly shall be made at 1½ times the shutoff head developed by the pump bowl assembly, or at twice the rated head, whichever is greater.

6.10.2. A standard hydrostatic test on the discharge head shall be made at the pressure defined in Sec. 6.10.1, less the pump setting specified on the order.

Sec. 6.11—Recording and Computation of Test Results

6.11.1. All instrument test readings, as well as corrected readings, shall be recorded on the test sheet. Complete data concerning the pump, driver, and instrument identification shall also be recorded.

6.11.2. All test results shall be translated into performance at the anticipated speed of the driver at the design point, using the following formulas:

$$Q = Q_t \frac{N}{N_t}$$

$$H = H_t \left(\frac{N}{N_t}\right)^2$$

$$\text{bhp} = \text{bhp}_t \left(\frac{N}{N_t}\right)^3$$

in which Q is capacity (gpm), H is head (ft of water), bhp is brake horsepower, N is anticipated operating speed (rpm), and subscript "t" indicates test values.

6.11.3. The bowl assembly input horsepower, when measured by a vertical dynamometer, is found from the expression KFN_t, in which K, the

dynamometer constant, equals $\frac{2\pi L}{33{,}000}$. L is the length (ft) of the lever arm, F is the net force (lb) at the end of the lever arm, and N is the speed (rpm) of the driver when the test reading is taken.

6.11.4. The motor power input, in horsepower, is the corrected kilowatt input to motor divided by 0.746.

6.11.5. The bowl assembly input horsepower to a pump driven by an electric motor is:

$$\frac{\text{kw}}{0.746}\,\eta_g$$

kw being the corrected kilowatt input to motor and η_g the motor efficiency from the calibration curve.

6.11.6. The pump bowl assembly efficiency (η_l) is:

$$\frac{Qh_l}{3{,}960 \times (\text{bhp})}$$

in which Q is the measured capacity (gpm); h_l is the bowl assembly head (ft), including velocity head; and bhp is the brake horsepower to the pump bowl assembly, measured by dynamometer or calibrated motor.

6.11.7. The pump total head (H), in feet, is found by:

$$H = h_l - h_c - h_e$$

in which h_l is the bowl assembly head (ft), from test; h_c is the column loss (ft), obtained from Fig. 5.2 and based on complete pump setting; and h_e is the discharge head loss (ft), from Fig. 5.3 or actual test.

6.11.8. The pump input horsepower equals the bowl assembly input horsepower plus the line shaft loss in horsepower. The bowl assembly input horsepower is calculated from test, as in Sec. 6.11.3 or 6.11.5. The line shaft loss is obtained from Fig. 5.3 and based on complete pump setting.

6.11.9. The pump efficiency (η_p) is found by:

$$\eta_p = \frac{QH}{3{,}960 \times \text{pump input hp}}$$

in which the pump total head (H) is obtained from Sec. 6.11.7 and the power input from Sec. 6.11.8.

6.11.10. The overall efficiency (η) is the pump efficiency (η_p) multiplied by the motor efficiency (η_g).

6.11.11. The complete pump total head, efficiency, and pump input horsepower should be plotted as ordinates on the same sheet against the capacity as abscissa to show the anticipated field performance of the complete pumps.

Sec. 6.12—Other Tests

For more complete tests, or for tests involving fluids other than water, refer to the ASME "Power Test Code for Centrifugal and Rotary Pumps" as applicable.

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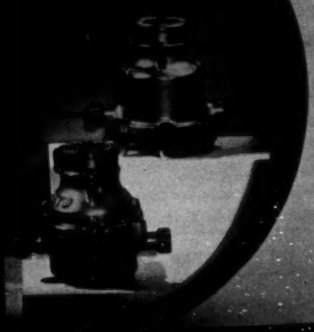

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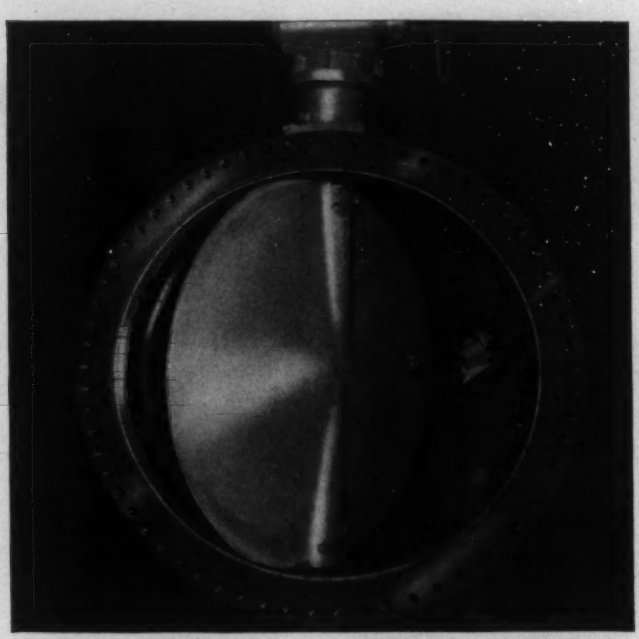

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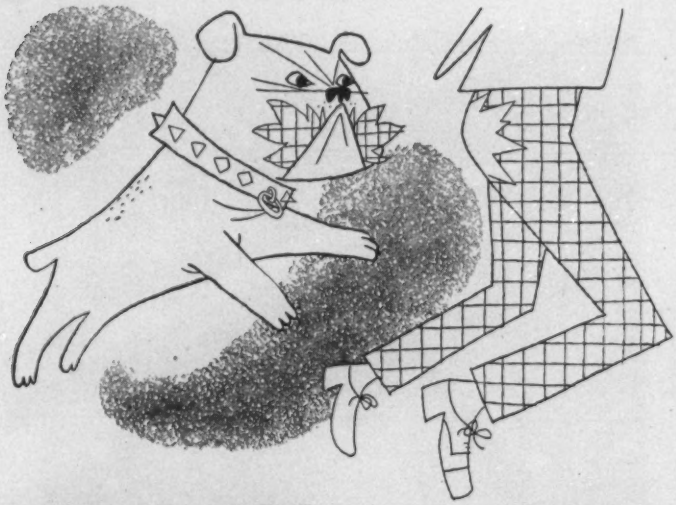

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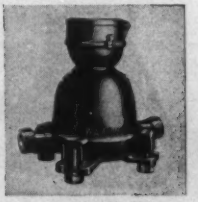

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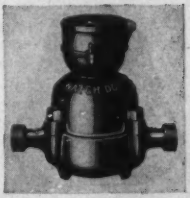

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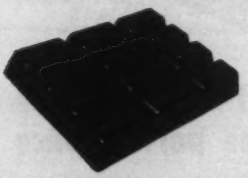

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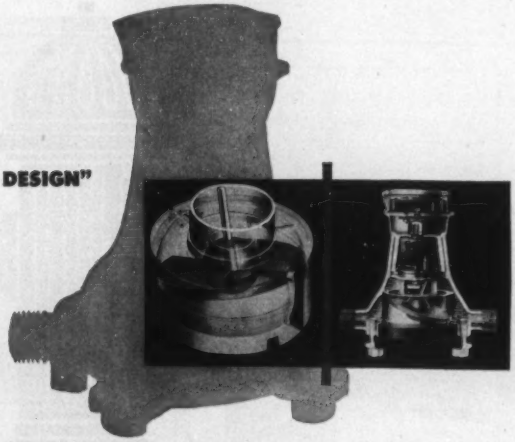

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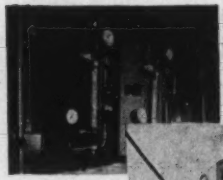

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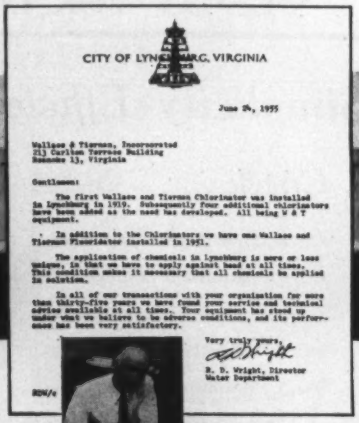

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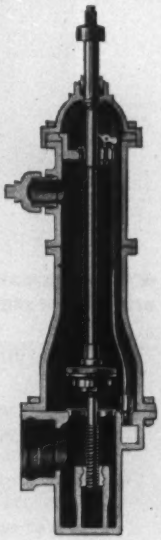

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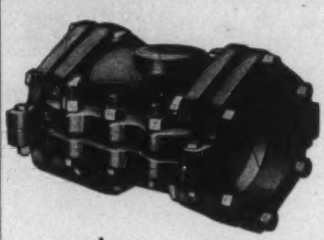

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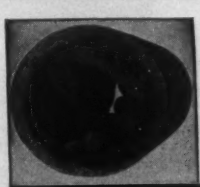

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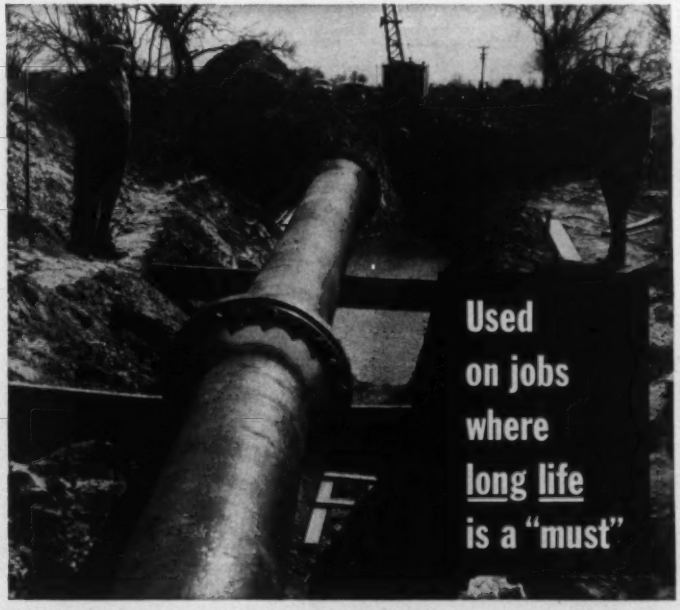

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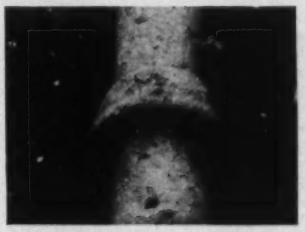

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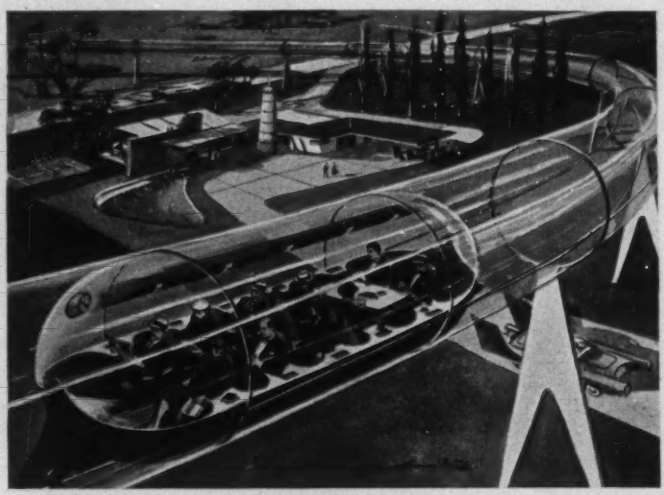

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